HUMAN-WILDLIFE (THE ETHIOPIAN WOLF AND GELADA BABOON) CONFLICT IN AND AROUND THE SIMIEN MOUNTAINS NATIONAL PARK

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Biology

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July, 2006

Dedication

This work has been dedicated to my father (Ato Yihune Tamene) and mother (W/ro Mulatua Mebrate). I wish you could have lived to see my success and rejoice with me. Dad and Mum, may the almighty God rest your soul in eternal peace.

ACKNOWLEDGEMENT

I would like to express my best gratitude to my Advisors Professor Afework Bekele and Dr. Zelealem Tefera for their invitation to conduct this study, excellent guidance, supervision and invaluable suggestion for the success of this work.

I sincerely thank the Frankfurt Zoological Society (FZS) for providing me the fund to conduct this study. Special thanks go to the Amhara Regional State Park Authority for allowing me to conduct the research in the Simien Mountains National Park.

It is my pleasure to thank staff members of the Simien Mountains National Park Office for their contribution in many aspects. Especially, I would like to thank Ato Nigussie Tsegaye (Park Warden) for his invaluable support. I am indebted to Ato Deribe Deksiyos (Ecologist in SMNP) and Ato Zeleke Tigabe (Education and community development worker in SMNP) for providing me with helpful information. I also thank Ato Getachew Assefa (field assistant of Afro-alpine Ecosystem Conservation Program) for introducing me the study area and assisting me in data collection. I am grateful to the staff of Kebele Administration for their co-ordination by organizing the community. I am also grateful to the staff of Abergina Primary School and Ambaras Health Center for their assistance and hospitality. Special thanks to W/t Kibirsew Mulatu for providing me useful data on the population status and economic activity of different villages. I would like to thank W/ro Tiruwork Bekele (librarian in Ethiopian Wildlife Conservation Organization) for her eagerness to help me and for her hospitality and I am also indebted to Ato Wondwosen Assefa (staff of Ethiopian Wildlife Conservation Organization) for helping me in drawing map of the study area. I sincerely wish to thank my friends and other graduate students for their company, moral support and friendship. The help provided by the administration of Biology Department, AAU is greatly appreciated.

Last but not least, my everlasting gratitude goes to my lovely family for their encouragement and support from the very beginning till the end of the study.

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Abstract

This study documents human-wildlife (the Ethiopian wolf and gelada baboon) conflict in and around the Simien Mountains National Park. Data were collected in between September, 2005 up to March, 2006 with fragmented short term stay by means of face-to-face questionnaire interview and by direct observation on the crop damage caused by gelada baboon. The Ethiopian wolf and gelada baboon faecal dropping samples were also collected to compare the result with the questionnaire survey. Data were analyzed using descriptive statistics and responses compared using Chi-square test and one-way ANOVA. Logistic regression model was used to analyze the attitude of respondents towards Ethiopian wolf and gelada baboon and to determine the factors that cause crop loss by gelada baboon. The analysis indicated that 74.3% of the respondents had positive attitude towards wildlife. There was significant negative correlation ($r = -0.28$, $P<0.001$) between problems caused by the wildlife and conservation attitude. 73.1% of the respondents had positive attitude towards the Ethiopian wolf and 70.3% of the respondents had positive attitude towards gelada baboon. There was negative correlation ($r = -0.2$, $P< 0.001$) between the attitude towards gelada baboon and crop loss. 6.9% of the respondents reported that they faced crop damage to wildlife where as 25.6% reported the problem of livestock predation to wildlife. 46.6% reported both the problem of livestock predation and crop damage. The result also indicated that 18.3% of the respondents reported the loss of sheep to the Ethiopian wolf. The average and the probability of sheep loss to the Ethiopian wolf per year per household were 0.62 ± 0.09 and 0.2% respectively. 97.8% of the Ethiopian wolf faecal dropping samples accounted for rodent prey where as 1.4% constituted sheep prey. Loss of livestock to common jackal, leopard, spotted hyena and hamadryas baboon has also been observed. The average crop loss by gelada baboon per household per year was 1.17 ± 0.1 quintal. But significant difference ($F_{7\ 292} = 13.49$, $P<0.001$) between villages in terms of crop loss by gelada baboon. There was also correlation ($r = 0.43$, $P<0.001$) between the type of crop grown and the type of crop damaged. Other crop raiders like hamadryas baboon, vervet monkey and crested porcupine were also observed. In general, there was strong conflict between gelada baboon and the surrounding people in some parts of the study area and there was some conflict with the Ethiopian wolf. Therefore, possible solution should be met to alleviate the problem.

Key words: *Wildlife Conflict, Ethiopian wolf, Gelada baboon.*

1. INTRODUCTION

Ethiopia is one of the most physically and biologically diverse countries of the world. It has an area of over 1,023,050 km^2. It comprises highland massive surrounded by arid lowlands. It contains various wildlife and wildlife habitats ranging from alpine moorlands to lowland savannas and arid lands, and extensive wetlands (Yalden, 1983). Most highlands harbor many endemic plants and animals. They have fewer species diversity than the lowlands in the country. The main reason for the presence of diverse wildlife and large number of endemic species is the rugged topography. This helped to create isolated and varied ecological situations. The biological resources are distributed in different biomes mainly the Afro-tropical highlands, the Sudan-Guinean, the Sahel-Transitional Zone and the Somali-Masai Biome (Yalden *et al*., 1996).

Ethiopia consists of 861 species of birds, 277 species of mammals, 201 species of reptiles, 63 species of amphibians and 150 species of fish (Hillman, 1993a). Among these, 31 mammals, 16 birds, 24 amphibians, 9 reptiles and 40 fish are believed to be endemic (Hillman, 1993a). This biodiversity is not evenly distributed in the country. For instance, large mammal species are common in the arid southern part. On the other hand, there are many smaller numbers of species in the highland where there is high population.

For millennia, the natural ecosystems of Ethiopia have been altered because of human and natural factors. Most of the highlands and some of the lowlands have been converted into agricultural and pastoral land. The vegetation has been used for fuel wood, construction and other purposes. As a result, wildlife resources of the country are now largely restricted to a few protected areas (Hillman, 1993a, b). In Ethiopia, the total area assigned for wildlife conservation is only 22,829 km^2. This means the principal conservation areas cover only approximately 2.9% of the country's surface area. This comprises 9 national parks, 3 sanctuaries, 8 game reserves and 18 controlled hunting areas (Hillman, 1993a, b). In Ethiopia, there are still habitats with different vegetation zones that are not represented as conservation areas.

The Simien Mountains National Park (SMNP) is one of the nine National Parks in Ethiopia. It occurs in North Gondar Zone. It has international significance due to its unique biodiversity, its high number of endemic species and its outstanding biophysical feature (Blower, 1969). The main reason for its biodiversity value is Ethiopia's geographical location on the border of two faunstic and floristic regions. These are the Ethiopian and the Palaearctic regions (Hurni and Ludi, 2000). The SMNP was originally established for the protection of the endemic Walia ibex (*Capra ibex walia*) (Linnaeus, 1758). However, the park also provides home to endemic species of mammals such as the Ethiopian wolf (*Canis simiensis*) (RÜppell, 1835) and the Gelada baboon (*Theropithecus gelada*) (RÜppell, 1835). Mostly the mountain ecosystems in the SMNP range from 1200 m asl up to 4,500 m asl. The presence of this pronounced topography results in a rich mosaic pattern of habitats. For example, the Ethiopian wolf, several rodents, shrews, white-collared pigeon and thick billed raven are located in such ecosystems (Hurni and Ludi, 2000).

Currently, the SMNP is facing heavy human pressure. The major human influence includes pasturing, deforestation, and ploughing the main sites of wildlife. The cattle population is high which results in overgrazing. Overgrazing leads to the replacement of soft grasses with hard one, prevention of tree regeneration and soil erosion (Klotzli, 1975). According to Hurni (1986), the annual soil loss on the cultivated land inside the SMNP is 80 tons per hectare. For instance, in 1989, 3326 hectare of the SMNP was cultivated and 360,000 tons of soil is washed away. The continuous cultivation by the local people leads to further degradation of soil depth and this could be one of the major causes for the negative impact on the status of the park.

The other major problem occurring in the SMNP is the high number of human population. Originally, the SMNP was established as a park encompassing a limited number of local people. Thus, the original human population is continuously increasing. This results in the expansion of settlement within the park (Falch and Keiner, 2000). Due to human encroachment, the wildlife in the SMNP including the endemic species like the Ethiopian wolf, Walia ibex and Gelada baboon have been facing challenges. This resulted in the human-wildlife conflict.

Therefore, the present study focuses on human-wildlife conflict (Gelada baboon and the Ethiopian wolf) in and around the SMNP. Collecting data on the extent of crop damage due to gelada baboon helps to see the degree of conflict. Moreover, sheep (lamb) predation by the Ethiopian wolf in the study area is also studied by using fecal analysis. Ultimately, the study also incorporates interview using questionnaire to evaluate various parameters. In the past, study on human-wildlife conflict was focused only on questionnaire as a means of socio-economic survey. However, this study incorporates both socio-economic and biological data.

2. LITRATURE REVIEW

2.1. The Gelada baboon (*Theropithecus gelada*)

The word “Baboon” came from French “babuin” which means a “gaping face” and “gelada” comes from an Arabic word meaning “mane” (Anonymous, unknown). The gelada baboon (*T. gelada*) is the only surviving member of the genus *Theropithecus* that occurred widely through the savanna grasslands of sub-Saharan Africa (Dunbar, 1986). Gelada baboons do not have close relations with the typical “baboons” of the genus *Papio*, but they have certain similarities in terms of ecological adaptation in morphology and behavior as part of convergent evolution (Crook, 1966).

Gelada was first discovered by the German explorer and naturalist RÜppell in 1835 (Crook, 1966). The average body mass for an adult male Gelada baboon is around 20 kg and for the female, it is between 13 and 16 kg. The male measures between 69 and 74 cm, and a tail between 45 and 50, the female is between 50 and 65 cm and a tail between 30 and 40 cm long. The males have a large mantle or mane surrounding their heads (Fig. 1). The chests of both sexes are hairless patch of skin that is heart shaped in males. Because of this, they are also known as bleeding heart baboons. Surrounding this skin are bumps of skin that swell up in females during estrus (Fig. 2). This area on the chest mimics the sexual skin during estrus (Anonymous, 2002).

Figure 1. Male Gelada baboon
(Photo: Anonymous, 2003)

Figure 2. Female Gelada baboon
(Photo: Anonymous, 2002)

2.1.1. Habitat and Feeding Behavior

The gelada baboons are terrestrial primates that live along the edges and steep slopes of open cliffs. They never move far from the rim and thus their distribution is linear along the escarpment (Last, 1982). Geladas are mainly vegetarian, feed upon herbs, grasses (most of the time) and roots but they also seldom eat insects. They never hunt or kill small birds and mammals. As a result, they are forced to spend most of their time in foraging and browsing to obtain sufficient nutrients (Last, 1982; Kawai, 1978). They forage by sitting down and shuffle along the ground and pickup grass blades using the thump and index finger.

2.1.2. Distribution

The Gelada baboon occurs in the highlands of Ethiopia particularly in the northern and southern parts of the Rift Valley highlands (Mori and Belay, 1990). The species has a disjunct distribution consisting of a large population which extends over the greater proportion of the northern Rift Valley highlands (Shoa, Gonder, Wollo and Gojjam provinces) and a southern isolated population limited to the southern Rift Valley Arsi region (Mori and Belay, 1990). Local distribution in certain parts of their range is limited by the presence of forest.

This includes both the primary high altitude *Juniperus* forest as well as the riverine forest which is dominated by species of *Ficus, Accacia* and other plants (Dunbar, 1998).

There are two sub-species of gelada baboons. These are *Theropithecus gelada gelada and Theropithecus gelada obscure.* The former occur north of Lake Tana and the latter found southeast of Lake Tana (Yalden, 1983). *Theropithecus gelada senex is* also considered as another sub-species located south of the Rift valley on the bank of Wabishebelle River (Mori and Belay, 1990).

2.1.3. Reproduction

Reproduction occurs within the reproductive units of the gelada baboon. The male gelada reaches sexual maturity at year 6 whereas the female at 4. Males begin to leave the herd at about 2 years of age, but all depart from the natal harem by the age of 5. However, females remain in their natal units for their entire life. Changes in the visual appearance of the sexual skins of female geladas are associated with different stages of the reproductive cycle (Dunbar and Dunbar, 1974). Changes in the appearance of the skin when the female is in estrus involve, change in tissue around the vulva from flat and pale to inflated and pinkish. Then it becomes deflated and becomes bright pink when they are pregnant. If conception is unsuccessful, the female's sex skins return to its original color and shape. Once the females reach sexual maturity, they may try to mate with the dominant male, but usually are unsuccessful. This is probably an adaptive behavior to prevent inbreeding (Anonymous, 2002).

The mating strategy for the female gelada is female choice. But for the male, it is male-male competition for the most possible copulation. Dominant males continually try to protect females from other males. Birth rates and mating are not consistently seasonal across the population. Bands and more specific units exhibit synchronized birth peaks. This is due to the high level of relatedness within units. Birth intervals are about 2.36 years. This means, the gelada have low reproductive rate and mortality rate. Hence, the population growth rate is one of the highest recorded rates among the primate populations (Dunbar, 1993).

2.1.4. Social behavior

The social behavior of apes and monkeys is evidence of a very high degree of intelligence and studying their rudimentary social structures provides considerable value in analyzing the origins of human social behavior (Last, 1982). The gelada social system consists of a hierarchy of social groupings. The basic group is the reproductive unit or harem (Kawai ***et al.***, 1983). Units of the gelada baboon are made up of one fully adult male, females ranging from 1-10 and their offspring. In the reproductive units, a strong social bond is shared by all of the females. The bond between the females is established because of high relatedness among them. The units forage together, sleep together and groom each other (Fig. 3). Grooming entails simply picking through each others fur. This is not only a friendly and peaceful occupation, but serves also to establish bonds between various members of a 'harem'. It also develops strong relationship in the hierarchy, between male, female, older and young members (Last, 1982).

Figure 3. Grooming (Photo: Anonymous, 2003)

In the reproductive units, there is always one dominant female, usually the youngest sexually mature female. Other females do not compete with her for seeking the male. A unit breaks up when it becomes too large (Dunbar, 1983). Bands are formed when the home range of the reproductive units overlap. Bands typically consist of 2-27 reproductive units and one to three

solitary males. Generally, 100 animals of all age and both sexes can be included in a single band (Dunbar, 1993). According to Dunbar (1993), the largest bands recorded contained 325-350 animals. Geladas forage together but do not groom with the members of other bands.

The other form of grouping in the gelada social organization is herd. Herd can be formed when the home range of bands overlap and geladas forage together. This usually happens when sufficient amount of food source is present. Over 400 individuals of gelada baboons can be grouped together in a given herd (Last, 1982). Within herds, each one-male unit remains spatially distinct from all others. However, there is also a tendency for certain units to occur in spatial association with others. Unit leaders maintain spatial separation between units by coming together with their females whenever the females approach too close to another unit or all-male group (Kawai, 1978). The composition of such various grouping changes gradually as a result of birth and death. But there is occasional group which results in a major change in size. Permanent migration of reproductive units between bands appears to be very rare. However, emigration by reproductive units to new ranging areas is more common (Dunbar, 1993).

2.2. The Ethiopian Wolf (*Canis simiensis*)

The Ethiopian Wolf (*C. simiensis*) has long legs and elongated muzzle. Its over all color is ochre to rusty red. The throat, chest and under parts are white (Fig. 4) (Sillero-Zubiri, 1994). The average weight of the male Ethiopian wolf is 16 kg whereas the female one is 12 kg (Sillero-Zubiri and Macdonald, 1997).

Figure 4. Ethiopian wolf (Photo: William, 2001)

2.2.1. Habitat and Feeding Behavior

The main habitat of the Ethiopian wolf is Afro-alpine, characterized by short grasslands (Sillero-Zubiri and Gottelii, 1995). The Ethiopian wolf commonly preys on small mammals and is specialized in rodent hunting. This makes it unique from the other carnivores. It feeds upon the endemic giant mole rats (*Tachyoryctus macrocephalus*), the common mole rats (*T. splendens*) and the grass rat species (*Arvicanthis abyssinicus*, *A. blicki*, *Lophuromys melanonyx* and *Otomys typus*). Besides the rodent species**,** the Ethiopian wolf has been seen chasing young antelopes, lambs, and hares (Sillero-Zubiri, 1994). The activity of the Ethiopian wolf is usually synchronized with the activity of rodents. It utilizes different hunting techniques in accordance with the size of the prey and forages throughout the day (Sillero-Zubiri and Gottelii, 1995).

2.2.2. Distribution

The Ethiopian wolf is probably the rarest canid in the world with fewer than 500 adult individuals surviving (Sillero-Zubiri and Macdonald, 1997). According to Sillero-Zubri and Gottelii (1995), it occurs in a few mountain ranges of the Ethiopian highlands. It occurs in the Simien Mountains, mountain tops of the Wollo highlands around Abune Yoseph, Amba Ferit, Donkoro Chaka and other high altitude areas of the Wollo region and in the North Shoa area of Menz (Guassa). It also occurs in Arsi and Bale Mountains of Senatti plateau and other high altitude areas (Marino, 2003). However, the proportion of the Ethiopian wolf is different in all these areas. The density of rodents in different habitats largely explains the difference in habitat preference by the Ethiopian wolf (Zelealem Tefera *et al*., 2005).

There are two subspecies of the Ethiopian wolf. These are: *Canis simiensis simiensis* and *Canis simiensis citernii*. *C. s. simiensis* is located in the area west of the Rift Valley in Simien. Whereas the *C. s. citernii* is found in the southeast of the Rift Valley in the Bale and Arsi Mountains (Yalden and Largen, 1992).

2.2.3. Reproduction

Both sexes of the Ethiopian wolf become sexually mature during their second year. Most mating occurs between August and November and copulation involves a tie of 15 minutes (Sillero-Zubiri, 1994). According to Sillero-Zubiri (1994), the dominant female of each pack gives birth once a year between October and December. The gestation period lasts between 60 and 62 days and 2-6 pups are born at a time.

2.2.4. Social behavior

The Ethiopian wolves live in packs. Packs of 3-13 adults unite together for social greetings and boarder patrol at dawn, noon and evening (Fig. 5) (Sillero-Zubiri, 1994). Members of the pack rest together at night but depart from each other to forage in the morning and early afternoon. During the breeding season, only pups and nursing females use the den. They sleep alone or in group (Sillero-Zubiri, 1994).

Figure 5. A pack of the Ethiopian wolves (Photo: William, 2001)

Social gathering is more common in the breeding season. It mainly takes place next to the den. The common interaction of the Ethiopian wolves within the pack involves food sharing, nibbling, and playing including chasing, ambushing and mock fighting. Moreover, energetic and noisy greetings are also crucial to promote cohesion and friendly relation within the pack. Scent marking of territory boundaries is made by urinating and disposition of faeces on conspicuous objects. In addition to this, scratching, fences and vocalization are common and

responsible for advertising and maintaining territories (Sillero-Zubiri, 1994, Zelealem Tefera *et al*., 2000).

2.3. Human-Wildlife Conflict

Naturally, organisms live together in an ecosystem for a long period of time. Then, through time, they show high degree of intrinsic stability and resilience to climate and other environmental factors in the given ecosystem. However, when humans entered these systems, the natural phenomena become disturbed. One of the effects of human activities is introduction of exotic species. Most of the introduced species cannot develop an adaptive co-existence with the native species. In addition, in many cases, the introduced species are not capable of resisting predators, disease and other factors that occur in the environment. This resulted in human-wildlife conflict (Messmer, 2000). No animal is inherently a 'nuisance' or 'pest'. However, because their habitats are increasingly altered or managed by humans, certain wild species or individual animals may cause a significant problem to humans, other animals or the environment (Anonymous, 2001). Wildlife and people can dwell harmoniously if and only if the animals feel safe from human threat and if animals are not causing property damage or public health concern (Einarsen, 2002).

Much of the current biodiversity crises arise as a result of increasing competition with humans for space and resources. Thus, protected areas become isolated islands of natural habitat and invaded by human settlement (Sitati *et al.*, 2005). Conflicts between human and wildlife populations are emerging as a major conservation issue worldwide. Crop raiders including elephants, many primates, several bird species, and rodents can diminish or destroy the farmers' food and cash crops. Carnivores and larger crop raiders are often presumed to be a threat and shot on sight (Anonymous, 2002).

Human-wildlife conflict incidents are widespread but not evenly distributed because they are dependent on the proximity of wildlife. In addition, different species cause different types of damage at different time of the year. The damage caused has different effects on the livelihood of households depending on their level of livelihood security before the incident (Mulonga *et al*., 2003). Human-wildlife conflict affects species, particularly large mammals. Due to such conflict, most are either critically endangered or declining rapidly.

One major cause for human-wildlife conflict is increasing human population adjacent to the protected area. As human population increases and the demand for resources grows, the frequency and intensity of conflicts between protected areas and local people will increase (Newmark *et al*., 1993). This can be manifested by increasing encroachment of wildlife habitat. As a result, species that are unable to adapt to altered habitats are forced to decrease their number and invade the marginal habitats. But those species that are able to adapt a changing ecology and survive in agricultural system become involved in a direct competition with humans (Kristin and Struhsaker, 1999; Deresse Dejene, 2003).

Increase in wildlife population in some areas can be considered as another cause of human-wildlife conflict. In the past, rural residents especially agricultural producers and tree growers were the cause of wildlife damage. However, more recently, urban dwellers and other wildlife stakeholders are highly experiencing wildlife damage (Messmer, 2000). Traditionally, wildlife damage was agricultural problem. But, even overabundant wildlife populations are causing many other problems like residential damage and disease. Moreover, human-wildlife conflict includes human illness, wildlife attack, animal automobile collision and other (Messmer, 2000). Human-wildlife conflict situations often have a long history. They are complex situations and are unlikely to be resolved quickly. They cannot be solved by technical means (Osborn, 2000). Past efforts to solve the conflict have failed in different areas. No solution will work without site specific knowledge that can be practical or acceptable in any situation in any particular area. The development of practical tools and techniques are required to minimize conflicts arising from human modification of ecosystems.

2.3.1. Human-Carnivore Conflict

Human-carnivore conflict is one part of human-wildlife conflict and occurs when the carnivore population increases or humans encroach on their habitats. Thus, Carnivores encounter more domestic animals and humans. Such encounter can cause danger to human and also increase economic loss. People often respond to this conflict by poisoning, shooting and trapping techniques that kill non-target animals in high proportion (Treves *et al*., 2003). Factors like human activities and carnivore behavior increase the risk of conflict. The presence

of dense vegetation appears to be a facilitator for livestock predation. According to Treves *et al*. (2003), placing pasture around vegetated waterways may promote sheep predation by wolf.

The occasional killing of livestock by wild predators can cause inevitable problems. The problem of livestock predation is prominent in a given area where extensive livestock husbandry is practiced (Oli *et al*., 1994). The presence of few numbers of wild preys may promote livestock predation. Many large carnivore species are adapted for ungulate predation but some individuals readily kill domesticated ungulates when they get the chance (Treves and Karanth, 2003). According to Vos (2000), prey selection by predators is related to the availability and size of prey. The decline in number of predator is probably related with the decrease in the number of livestock and lack of wild preys (Vos, 2000).

Under a variety of demographic, economic and social pressure, human alteration of carnivore habitat or exploitation of carnivores has led to conflicts. On the other hand, humans also allow the recovery of carnivore population and promote conflict with them by rehabilitating the deforested area. For example, in many parts of the United States, changing land-use practices can be considered as the regrowth of forests providing room for potential recolonization of carnivores (Treves and Karanth, 2003). Humans are the cause for most of the carnivore mortality world wide and most of the recent reduction of carnivore population (Treves and Karanth, 2003). Human caused mortality is a major factor in many wolf populations. At least 15% of the wolf population in North Central Minnesota is shot or trapped illegally each year (Tucker and Pletscher, 1989). In turn, 51 people were attacked by carnivores between 2001 and 2003 in the Junnar Forest Division, Maharashtra (Western India), of which 18 people died and 33 were injured (Athreya *et al*., 2004).

Large carnivores such as the brown bear (*Ursus arctes*) (Linnaeus, 1758), wolf (*Canis lupus*) (Linnaeus, 1758) and Eurasian lynx (*Lynx lynx*) (Linnaeus, 1758) were all widespread throughout Europe in the past. Wolves used to occupy all habitat types of the northern hemisphere except tropical rain forests and deserts. The brown bear originally used to occupy the whole temperate zone of the Holarctic region. The lynx was restricted to Europe in the past. All these carnivore species have declined at present (Breitenmoser, 1998). The major

reason for the decline is the increasing of human population. Whenever humans settle, they disturb the large predators because of their threat to livestock. Other reasons for the substantial decline of large carnivore are forest destruction and the expansion of cultivated land.

Livestock provided seasonally abundant alternative prey for the large carnivores. For example, an increasing number of domestic animals destroy the forest habitat and compete with the wild ungulates. The large carnivores are forced to kill livestock which leads to frustration of the herdsmen (Breitenmoser, 1998). According to Breitenmoser (1998), carnivores respond to human activities based on the response to environmental changes. Killing predators to protect livestock is one of the most controversial issues in natural resource management. So, there is an increased interest in the use of non-lethal methods to reduce predation. The use of guardian animals like donkey, ostriches, kangaroos, and llamas has received special attention. Properly trained and maintained dogs can reduce sheep loss to predation (Cavalcantic and Knowlfan, 1998). There are some disadvantages associated with using dogs as livestock guardian. This involves: (i) injury or death of sheep resulting from playful behavior of the dog, (ii) aggressiveness towards people, and (iii) destruction of property by chewing or digging. Therefore, as an alternative to dogs, llamas are becoming popular among some livestock producers, particularly in the western United States.

In general, many carnivores escaped extinction during the last century as a result of legal protection, habitat restoration and changes in public attitudes. However, conflicts among carnivores, livestock and humans are increasing in some areas. For instance, in Africa, the endangered wild dogs range usually beyond the boundaries of protected areas and may be exposed to lethal control by farmers (Woodroff *et al*., 2005).

2.3.2. Human-Herbivore Conflict

This is another major type of human-wildlife conflict. Large mammals cause crop loss near protected areas among agriculturalists in many parts of Africa and Asia. The extent of damage is almost insignificant when it is considered at the global level as compared to the damage caused by invertebrates and rodents. However, in the area where large number of animals occurs, the whole season production may be lost in a single night (Naughton-Treves, 1997).

Wildlife damage varies considerably from site to site and farmers have unequal capacity for preventing losses. Farmers themselves are sometimes, the causes for crop loss because they continuously change the vegetation structure of the land closer to the protected areas. This changed vegetation probably becomes attractive to wild herbivores. Cultivated plants having characteristics of increased yield, rapid growth and resistance to disease may be vulnerable to the herbivory of locally overabundant wildlife population (Messmer, 2000). According to Kimega (2003), in Kenya, food items such as maize, cassava, beans, potatoes, and fruit trees are the target for the hungry such as elephants, baboons, zebra, buffalo and wild pigs.

Among those common agricultural pests (primates, rodents, birds or insects), the damage caused by elephants is often far grater (Hoare, 2000). This is because elephant raids are unpredictable and can cause more damage per raid. Almost all countries in Africa including Ethiopia reported problems with elephant crop raiding (Yirmed Demeke, 1997). Subsistence agriculture is the sector more exposed to elephant damage than other crop pests. Generally, it is difficult to alleviate the conflict between herbivores and human. But it is possible to minimize it using different conservation measures.

2.3.3. Human Impact on Wildlife

Humans obtain many goods and services from nature to sustain their demand for food, fuel, water, medicine and fiber. Development including construction of roads, dams and utilities support human beings to accomplish the daily activities. But, these activities weaken the long-term sustainable development by propagating unintended environmental impacts. Development intended for simple industrial purposes often result in uncontrolled secondary human migration, illegal logging, hunting and resource extraction in general (Anonymous, 2001). Further more, the various dams built which intended to supply water for irrigation and non-fossil hydropower result in decreased water supply further down stream, high methane emission from some reservoirs, and draining of wetlands with enormous impact on biodiversity and migratory species. The greatest human vulnerability to environmental degradation is related to effects on water resources, health and land productivity. Water pollution mostly occurs in the industrialized countries and uses of high energy also contribute a lot to global climate change.

The different activities of humans have its own impact on wildlife by modifying the behavior of animals and species distribution. The disruption of behavioral patterns can affect their social structure because social structure is a key component in the evolution and dynamics of species. Thus, its disruption by human disturbance can have a considerable effect on population performance even if the disturbance does not directly affect the survival and reproduction (Manor and Saltz, 2003). Factors like noise, disruption of the physical environment including migration, alteration of the chemical environment and introduction of exotic species are responsible for disturbing the regularity of wildlife. The ecological impacts of losses of habitat and redistribution of animals away from development areas may affect the foraging success or survival in areas beyond the initial zone of disturbance. This results in overgrazing, erosion, changes in predation pressure and breeding (Anonymous, 2001).

Increasing human population and the associated impacts such as habitat loss and hunting are the underlying factors for the decline of mammalian species. They are considered as species threatening factors and vary in intensity across the surface of the earth. Species that inhabit more heavily impacted regions are expected to have a higher risk of extinction (Cardillo ***et al***., 2004). Illegal or traditional exploitation of wildlife within conservation areas for both subsistence and economic gain is common. For example, as reported by Leader-Williams ***et al***. (1990), the decline of black rhinos (***Diceros bicornis***) (Gray, 1821) and elephants (***Loxodonta africana***) (Gray, 1821) in many countries of Africa is due to overexploitation.

In Africa, the regular trend is that core protected areas like national parks are becoming ecologically isolated as people settle and increase in the countryside. If this trend continues, one can expect the complete collapse of the core area. Through time, wildlife is lost from the country and the core areas themselves are lost. The trend of an increasing human dominated landscape will continue and larger mammals continuously will only be restricted to parks and reserves (Hackel, 1999). In general, humans either directly or indirectly influence the survival of wildlife and are responsible for the extinction of many species.

2.3.4. Public Attitude towards Wildlife

Attitude can be defined as a predisposition to act in a favorable or unfavorable fashion towards some object. It is considered as a precursor and an important predictor of willingness. For instance, a study on the wolf restoration in Yellowstone National Park showed that increasing distance from wolf range is seen as a more positive attitude towards the species (Bath and Buchanon, 1989).

These days, the conflict between local people and wildlife is taken as the major conservation issue (Newmark *et al*., 1993). The conservation attitude of local communities living adjacent to the protected areas is highly influenced by the problems associated with wildlife. People living surrounding the protected areas who are unable to control the losses caused by wildlife are likely to develop negative attitude towards wildlife (Newmark *et al*., 1993, 1994). Especially, in communities with a subsistence economy, even small losses can generate strong negative attitude towards wildlife (Oli *et al*., 1994). As reported by Newmark *et al*. (1994), in Tanzania, conservation attitude of local people living adjacent to the protected area is strongly influenced by problems with wildlife. On the other hand, people who get benefit from natural resources are likely to support the wildlife conservation efforts and protected areas (Zelealem Tefera, 2001).

Human attitudes and values about wildlife vary both among and within different sectors of the society. The views of rural residents about wildlife may not differ from urban residents except that they personally experience more of the benefits and problems caused by wildlife. However, farmers are one sector of the society whose attitudes about wildlife continue to differ from other stakeholders. They continue to view wildlife in terms of its importance and tend to be more concerned about how wildlife affects them economically (Messmer, 2000).

Whatever the case, public understanding of the general environment and population related issues is critical for successful conservation efforts. For this, the perception of local people towards the natural resources and the effect of interaction of people should be studied.

3. OBJECTIVES

3.1. General objective

- ♣ to investigate the extent of human-wildlife conflict (mainly the Ethiopian wolf and Gelada baboon) in and around the Simien Mountains National Park.

3.2. Specific objectives

- ♣ to reveal the human impact on wildlife.
- ♣ to reveal the impact of wildlife on the local people and livestock.
- ♣ to show the degree of conflict from faecal analysis.
- ♣ to suggest possible solutions to mitigate the problems caused by the Ethiopian wolf and gelada baboon.

4. THE STUDY AREA

4.1. Location

The Simien Mountains National Park (SMNP) is about 885 km north of Addis Ababa. It is part of the Simien Mountains (between $38^{0}00'$-$38^{0}12'$E and $13^{0}12'$-$13^{0}19'$N) in the North Gondar Zone of the Amhara National Regional State (Fig. 6).

The Amhara National Regional State covers 179,062 km^2 and is subdivided into 11 Zones of which the North Gondar Zone is the largest. The North Gondar Zone covers 62,020 km^2 with 732 Kebeles. The economic activity of this Zone is largely dominated by peasant agriculture with low productivity of labor and land. About 80% of the North Gondar Zone populations live in the highland, "Dega" (2400-3400 m asl) and "Woina Dega" (1500-2400 m asl) Zones. This type of topography and climate are the causes of frequent drought and famine, particularly in the north and east of the North Gondar Zone (Falch and Keiner, 2000).

The Simien Mountains National Park has an area of 136 km^2 but recently the area has been extended to 205 km^2. It lies in the Woredas of Debark, Adi Arkay and Janamora. It occupies chains of plateau and grassy plains. The area is part of the Simien massif which includes the highest peak in Ethiopia, Ras Dejen (4,543 m asl). The massif was formed 25 million years ago. In the process, the igneous basalts have been eroded to form precipitous cliffs and deep gorges. Some cliffs reach 1,500 m asl and extend for long distances (the north scarp extends 35 km). The plateau is bounded on the south and northeast by deep valleys of Tekeze River (Nepal, 2000).

SMNP represents one of the most marvelous natural areas. The presence of high number of endemic species, unique bio-physical features, and its international significance made SMNP to become a World Heritage Site in 1978. However, in 1996 it was inscribed on the list of World Heritage in Danger. This is because of the recent deterioration of the Walia ibex (*Capra ibex walie*) population, agricultural encroachment, loss of biodiversity and impact of road construction (Falch and Keiner, 2000).

The original settlers of the Simien Mountains are the Ethiopian Jews ("Felasha"). The Felasha settlements were extended until 1960. Then, from 1988 up to 1991 the Jewish populations moved to Israel. Before the 1960s, SMNP was used as a Controlled Hunting Area. In 1960s, the Ethiopian Wildlife Conservation Organization (EWCO) employed a warden named Nicole. SMNP was nationally gazetted in 1969. However, between 1976 and 1991, it was seriously disturbed by the conflict between the military government and the opponent groups. In 1979, villages located in the lowland areas like Truwata, Tiya, Dirni, Antola and Muchila were destroyed. In 1999, development effort began to rehabilitate the damaged infrastructure inside the park (Falch and Keiner, 2000).

4.2. Topography

The topographic feature of SMNP is characterized by marvelous landscape composed of a broad undulating plateau. It is also known by its precipitous cliffs, deep gorges, canyon-style escarpments and peaks. The topography of SMNP is divided into four main groups (Hurni, 1986).

1. The lowland valleys below 2000 m asl.
2. The lowland terrace steps formed by geologic processes. It comprises the main cultivation and settlement area.
3. The steep escarpment between 2000 to 4000 m asl which consists of the main habitat of wildlife.
4. The highland plains and valleys of the escarpment which is a densely cultivated and settlement area.

4.3. Geology

The volcanic activities resulted in spectacular scenery to the SMNP. The 3000-3500 m thick sequence of basaltic volcano was deposited on Mesozoic sandstones and limestone that form a 500 m thick cover of the Precambrian crystalline basements. The main part of the Simien Mountains is built up by plateau basalts that are called the Trap series. They are composed of numerous 4 to 50 m thick lava-flows (Falch and Keiner, 2000). The major part of the Simien Mountains consists of remnants of a Hawaiian-type shield volcano. The Kidus Yared Mountain is situated near to the center of the shield volcano.

Ras Dejen (4543 m asl), the Bwahit (4430 m asl) and Silki are formed from the outer core of this ancient volcano (Falch and Keiner, 2000). The shield volcano is mainly built by several meters thick augite-basalt-flows. The extreme escarpments in Simien appear to be a precondition for the formation of the extended up lift of the whole massif. Harder rocks on the foot of the escarpment were responsible for the development of large-scale terrace like steps (Hurni, 1986).

4.4. Soil

There are different soil associations in SMNP. The Humic Andosols are the dominant soil type at the altitude of 3000 m asl and above where cultivation is less spread. The other types of soil are shallow Andosols and Lithosols that are mainly common in the area between 2500 and 3500 m asl. Below 3000 m asl, the typical soils are Haplic Phaeozems associated with Cambisols and Lithosols (Falch and Keiner, 2000).

4.5. Climate

The climate in Ethiopia is influenced by the Southwest-Northeast Indian Ocean monsoon system, the Atlantic wind streams from the west, and the mass of the Ethiopian highland blocks. Therefore, most of the Ethiopian highlands receive rain from March to October. More amount of rainfall is received from June to September (Falch and Keiner, 2000).

The climate of SMNP varies from area to area. Generally, the highlands have a relatively low temperature. They are cold in the early mornings of the dry season and receive rain 1500 mm on average in a single rainy season (from May to October) (Hurni, 1986). The climatic difference between the escarpment and the gorge is the cause for the difference in vegetation type. The difference in microclimate between the gorges and the escarpments is reflected by the extent to which the trees are covered with lichens. This is very prominent on the escarpment and rare on the gorges (Dunbar, 1978).

There are 4 climatic zones in SMNP. These are:

A. Wurch Zone (over 3700 m asl) - an alpine climate where no cultivation is possible.

B. High Dega Zone (3400-3700 m asl) - is a cool climate which allows barely and potato cultivation.

C. Dega Zone (2400-3400 m asl) - a temperate climate where cultivation of wheat and pulses is observed.

D. Woina Dega Zone (1500-2400 m asl) - a sub-tropical climate which is appropriate for maize, teff and pulse cultivation.

4.5.1. Temperature

The temperature of SMNP shows high diurnal variability. The annual minimum temperature ranges from -2.5^{0}C to -4^{0}C in January and maximum temperature from 11^{0}C to 18^{0}C in April. Occasionally, snow occurs at altitude above 3800-4000 m asl. But, it does not form a permanent snow cover on the mountain tops. This is because snow line is estimated at 5000 m asl, about 450 m above the peak of Ras Dejen (Falch and Keiner, 2000).

4.5.2. Rainfall

In the SMNP, the annual rainfall ranges from 1350-1600 mm. The wettest parts lie to the lowland and along the Northern escarpment. The Eastern escarpment which is located along the Tekeze River receives rainfall later than the Northwest. The total amount of rainfall received by the Eastern escarpment is lower than that of the Northern escarpment. There is only one wet season beginning usually from late May or early June and continuing till mid-October. Although, rain is expected in most months of the year, the bulk of the annual precipitation falls from May to October (Dunbar, 1978).

4.6. Accessibility

There are two ways of transport to visit the SMNP. The first one is using car from Addis Ababa to the Park. The other is using Airplane from Addis Ababa to Gondar then moving by car from Gondar to the Park. The public transport from Addis Ababa is only restricted to Debark. Then from Debark to the park, the local people have been using lorry. However, recently, the Regional Transport Agency allocated a bus per day to the park. Beside the car transport, most of the local people and some tourists use track and pack animals like mule, horse and donkey.

4.7. Land use and Settlement

The principal ethnic groups found in the Simien Mountains are the Amhara. In the east, below the escarpment in Beyeda, there are Agew people. These people are mainly sedentary agriculturalists with a mixed farming system based on crop cultivation complemented by livestock products (Nepal, 2000).

About 86% of the Park is used by humans at various levels of intensity. Grazing is not as such significant, but farming causes much more harm (Falch and Keiner, 2000). There are 20 villages which are incorporated in 11 Kebele associations that defend their traditional rights to land use inside the Park. According to Nepal (2000), almost 5,000 households with a total population of about 28,000 live in and around SMNP. Some 10,000 people either live on, or use land and other resources inside the park. Today, there is no possibility of expanding agricultural land. This is because the potential areas are now inaccessible or within the National Park boundary. The human population in and around the SMNP is still growing with no change in agricultural land. In order to meet the household food demands, the only way is to minimize or even give up the fallow periods. However, this situation diminishes the productivity of the soil and increases soil degradation.

4.8. Vegetation

The rich natural vegetation of SMNP only exists due to the steep gorges. It mainly consists of a mixture of Afro-alpine woods, heath forest, high mountain vegetation, montane savannah and montane moorland (Hurni and Ludi, 2000). In the SMNP, 57 tree species and herbaceous plants have been recorded. The common vegetation includes ***Erica arborea, Lobelia rhynchopetalum, Solanum spp., Rosa abyssinica,*** everlasting ***Helichrysum spp., Hagenia abyssinica, Rapamea mesanophloeos, Pittosporum viridiflorum, Ekebergia apensis, Allophylus abyssinicus, Hypericum revolutum, Fastuca gelbertiana, Rasularia simiensis*** and mosses. In addition to this, herbs like ***Tymus spp., Trifolium spp., Geranium arabicum***, ***Rumex nervosus, Otostegia minucci, Clematis simiensis*** and ***Galium spurium*** grow on the top of ridges and sides of gorge (Hurni and Ludi, 2000). There are over 20 endemic plant species within and in the buffer zone of the SMNP. Of these, 3 are exclusively endemic to the Simien Mountains.

These include ***Fastuca gilbertiana, Rosularia simiensis*** and ***Dianthus longiglumi*** (Falch and Keiner, 2000).

Generally, according to Falch and Keiner (2000), there are three main groups of vegetation cover in the SMNP.

1. Afro-alpine steppe belt (3800-4400 m asl)

Between 3800 m asl and 4200 m asl, there are scattered grass and large number of ***Giant lobelia rhynchopetalum.*** Other species like ***Danthonia, Fastuca*** (up to 3800), ***Pentaschistis, Agrostis*** (above 3800 m) and ***Poa simiensis*** also grow in this area. Moreover, the Red hot pocker (***Kniphofia foliosa*** and ***K. comosa)*** provide the red and yellow flowers, and silver straw flowers (***Helichrysum spp.***) and make the area highly attractive.

2. Sub-alpine highland belt (Ericaceous belt 3000-3800 m asl)

Such type of belt is only found on the escarpment areas. The most prominent vegetation in the sub-alpine forest belt includes ***Erica arborea, Erica trimera,*** Giant St. John's wort ***(Hypercium revolutum)***, and ***Giant lobelia rhynchopetalum.*** Other remarkable plants to the Simien Mountains are the Abyssinian wild rose ***(Rosa abyssinica***) and Giant sphare thistle (***Echinops giganteum***). There are also mosses (***Grimmiaceae***) and lichen ***Usnea spp.*** that cover the high altitude forest trees. Finally, plants like ***Tymus spp., Trifolium spp., Geranium arabicum, Rumex nervosus, Otostegia minucci*** and ***Clematis simiensis*** and ***Galium spurium*** occur at the top of the ridges and sides of gorges.

3. Afro-montane forest belt (2000-3000 m asl)

The Afro-montane forest belt is characterized by the presence of more than 20 tree species. ***Juniperous procera, Hagenia abyssinica, Olea chrysophylla, Cordia, Ficus*** and ***Szygium guineense*** are common trees in the area. Moreover, ***Solanum spp., Rosa abyssinca, Primula verticullata, Alchemilla, Tymus,*** and ***Urtica*** are the other types of plant growing in the Afro-montane forest belt. The biodiversity of Afro-montane forest belt is much greater than that of the biodiversity growing on the highland plateau.

Based on the location and the type of the vegetation present, the Afro-montane forest belt is classified into two. These are: the wet afro-montane forest and the dry afro-montane forest. The wet afro-montane forest patches are located on the north or northwest facing slopes and in steep and shady gullies. For instance, ***Albizia schimperiana*** dominated forest is considered to be wet afro-montane forest patches. The dry afro-montane forest patches are found on slopes facing south or southeast. They are typically characterized by the presence of extremely few species.

4.9. Fauna

The SMNP harbors various animals due to its topography. The numerous species of mammals and birds existing in SMNP indicate its unique ecosystem (Hurni, 1986). In the SMNP, 22 large mammals, 13 small mammals and 180 bird species have been recorded. There are some species of mammals, birds, rodents and shrews which are either endemic to SMNP or to Ethiopia. These include Walia ibex (*Capra ibex walie*), Ethiopian wolf (*Canis simiensis*), Gelada baboon (*Theropithecus gelada*), the grass rat (*Arvicanthis abyssinicus*), wattled ibis (*Isostrychia carunculata*) and Thick-billed raven (*Corvus crassirostris*).

5. METHODS

5.1. Preliminary study

The preliminary survey was conducted in August, 2005. During this period all the available and relevant literature on the Simien Mountains National Park were reviewed. Attempts were also made to find information on accessibility, climate, vegetation, fauna, topography, infrastructure and approximate size of the core area of wildlife. Information was gathered on the extent of crop damage since locals are aware of the problem (Kangwana, 1996). To incorporate this, pilot survey was designed.

5.2. Pilot survey

Pilot survey was conducted in and around the Simien Mountains National Park from September to October, 2005 based on the information gathered during the preliminary survey. During the pilot survey, 46 individuals were randomly selected and interviewed in the study area. The main purpose of the pilot survey was to evaluate the questionnaire and to check whether it is applicable and suitable in the study area. It is also used to check the question understood by the people. The pilot survey was also used to identify the period and areas of human-gelada baboon conflict. In addition, it is used to identify the area where the conflict between humans and the Ethiopian wolf occur. Then based on the result from the pilot survey, the questionnaire was revised and developed.

5.3. Data collection

The actual data collection was conducted between November, 2005 and March, 2006 with fragmented short term stay.

5.3.1. Questionnaire survey

A total of 300 people were interviewed using questionnaire. Of these, 72 respondents were females where as 228 were males. The questionnaire was designed mainly to check whether there is a human-wildlife conflict or not in and around the SMNP. It was also designed to assess various parameters in relation to the issue. The questionnaire included both open-ended and fixed response questions. Open ended questions were included to elicit information on

knowledge about wildlife in the area, whether wildlife posed any problem in the community, cases of the Ethiopian wolf and other carnivore predation on livestock and attitude towards wildlife. Those respondents who knew less than 3 local wildlives considered as they have poor knowledge about the surrounding wildlives where as others that knew 3 - 4 kinds of wildlives considered as they have good knowledge. In addition, those who knew 5 - 6 kinds of local wildlives and above 6 kinds of wildlives considered as they have very good and excellent knowledge about local wildlife respectively. Respondents were asked whether conserving wildlife is important or not. Then their answer was considered as positive if they replied as conserving wildlife is important. However, if they respond as conserving wildlife is not important; their answer was considered as negative response. The positive attitude represents the respondents' good will to protect and utilize the local wildlife wisely whereas the respondents' negative attitude towards wildlife represent unwilling to utilize their natural resource in a wise way rather wish to destroy it.

A series of supplementary questions were also used in the questionnaire to gather personal and socio-economic information at the level of individual respondent (see Appendix I). Then using the questionnaire, the interview was conducted in 8 randomly selected villages. Villages were selected based on the information gathered using the pilot survey. These were Abergina, Gich, Mecheka-Tikurwuha, Kiflo, Daba-Johna, Deguale, Zinababre, and Woizero Mesk. Gich located in the park where as Deguale, Zinababre, and Woizero Mesk located very far from the park. The remaining villages located with in the buffer zone. The interviewees were selected on the basis of chance encounter by the interviewer (Newmark, *et al.*, 1993).

5.3.2. Faecal Analysis

According to Putman (1984), ecological information may be deduced from the analysis of faecal deposits. A total of 73 faecal samples of the Ethiopian wolves and 100 faecal samples of Gelada baboons were collected from the study area. The Ethiopian wolf faecal dropping samples were collected from Gich-Aynameda, Atere and Adilemlem. Gich-Aynameda is located around Kiflo and Jona-Daba villages. Therefore, livestock from these villages graze in Gich-Aynameda area. In addition to this, Adilemlem area included villages like Deguale, Woizero Mesk and Zinababre. Further more, since Atere area is near to these villages,

livestock grazing from such villages occured. Hence, such area was also ideal to see whether there is sheep loss to the Ethiopian wolf or not from those villages. On the other hand, gelada baboon faecal dropping samples were collected from Tikurwuha, Abergina, Kiflo, Jinbahir and Gich.

Date of collection, age of faeces, time of collection, location, altitude of the collection site and position were recorded (see Appendix III and Appendix IV). The age of faecal samples was categorized into fresh (1 day old), recent (2-5 days old) and old (above 5 days) (Breuer, 2005). Identification of carnivore faeces was carried out based on shape, colour, ingested hair, diameter and odour following Breuer (2005). Identification of the faecal droppings of the Ethiopian wolf from common jackal and other related carnivores was conducted using the shape and colour of faeces. Faecal samples were collected by identifying the home range of the Ethiopian wolf. Those faecal samples located close to each other were not considered to avoid collection from the same individual. The faecal samples of the Ethiopian wolf were sun dried, ground in a mortar, and washed in a sieve (1mm) using hot water to separate hairs, bones, teeth and other prey components from other organic material. Then the separated hairs were washed in acetone, dehydrated in 100% ethanol and dried on filter paper. Hair was analyzed macroscopically by considering form, length and color (Breuer, 2005).

The faecal samples of gelada baboon were analyzed macroscopically to determine the presence or absence of locally abundant seeds in the study area (Remis, *et al*., 2001). The presence of seeds (for cereal crops) was designated by 1 and the absence was designated by 0. It is not possible to accurately measure the proportion of plant species eaten in faecal analyses (Remis, *et al*., 2001).

5.4.3. Direct Observation on Crop Damage by Gelada baboon

To observe the extent of crop damage by Gelada baboon and to compare the result with the response given by the local people, five sites were randomly selected. These sites were Kiflo, Abergina, Jinbahir, Jinbahir Ras and Tikurwuha (Fig. 6). These areas were important to see the extent of crop damage by gelada baboon. The farmlands in Jinbahir belonged to residents of Mecheka-Tikurwuha whereas farmland in Jinbahir Ras belonged to residents of Gich village.

Five grids were constructed in those five selected sites (one grid on each site). Each grid covered 31,250 m^2. Each grid was further classified into five cells, where each cell has an area of 6,250 m^2. For each cell, the type of crop grown, condition of crop before damage, area of damaged portion, part of plant eaten and crop species eaten were recorded (Naughton-Treves, 1997) (see Appendix II). Since the grids consisted of areas with sown crops like barley, wheat, pea, bean, oat and linseed, the damaged portions were estimated directly in m^2 (Sukumar, 1989). The distance of the crop field forest (park) edge from closest distance to the point of damage was recorded (Naughton-Treves, 1998). Each grid was visited five times at three days interval. Only those crops that were eaten by gelada baboon in the three days interval were recorded.

5.4. Data analysis

All the data collected were analyzed using SPSS version 10 computer software program. Data were analyzed using descriptive statistics and responses compared using chi-square test and one-way ANOVA. Tukey test was used to identify the real difference after a one-way ANOVA test. For the data gathered using questionnaire, logistic regression was used to determine which factors might be important in determining the attitudes of respondents expressed as positive or negative responses. For this, using the General Linear Model, variables like age, sex, distance from the park, educational level, village, family size, is conserving wildlife good/bad, and others were entered. In addition, it is also used to determine which factors might be important in determining the presence or absence of crop damage by gelada baboon, and other problems caused by wildlife.

6. Result

6.1. Questionnaire Survey

6.1.1. Socioeconomic Pattern

The trend of human population increases in and around the Simien Mountains National Park (Fig. 7). At present the human population density in the study area is greater than 100 people per km^2.

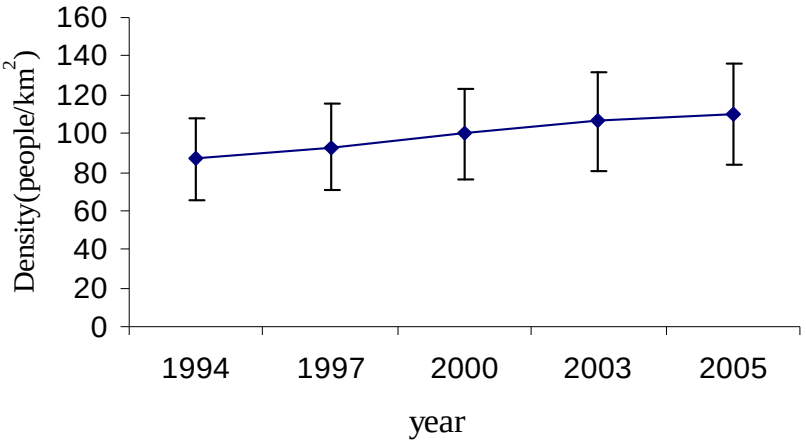

Figure 7. Change in population density of people living in and around the Simien Mountains National Park.
(Source: CSA, 1995 and Kebele Administration)

The age of respondents ranged from 14 to 78 years (Fig. 8). There was no age difference between the male and the female respondents ($F_{1\ 298}$ = 2.73, P> 0.05).

Most respondents (33.3%) live more than 5 km away from the park boundary, whereas 28% of the respondents live between 1 and 5 km away from the park boundary. 26.3% of the respondents live very close to the park boundary (< 1 km) and 12.4 % inside the park (Fig. 9). In general, a total of 66.7% of the respondents live in the park and up to 5 km away from the park.

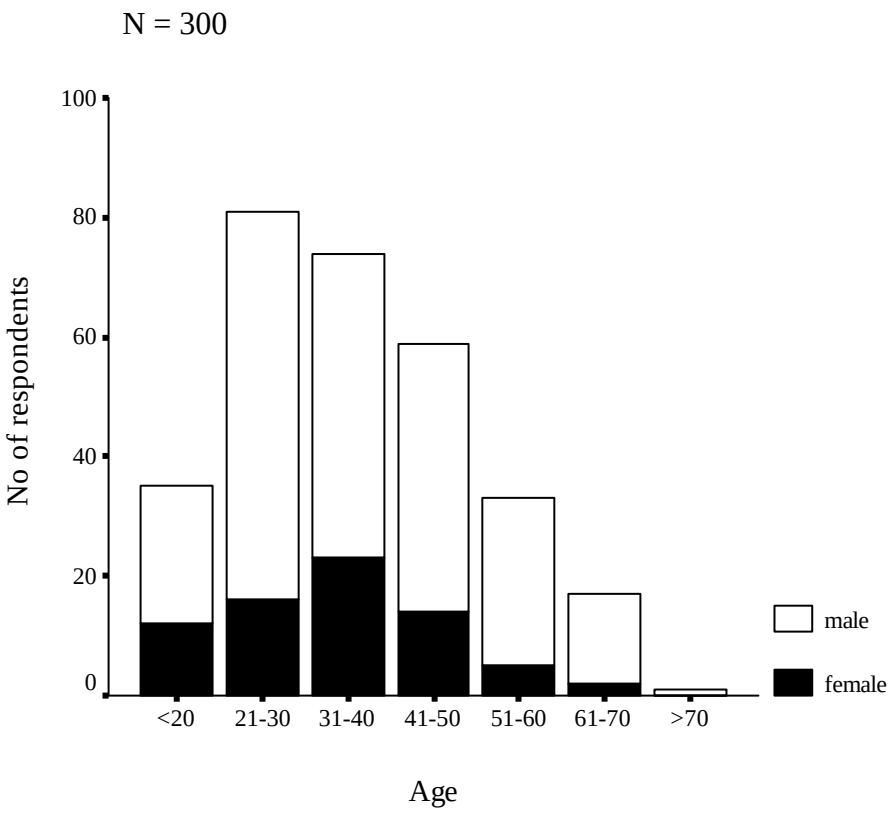

Figure 8. Age classes of respondents.

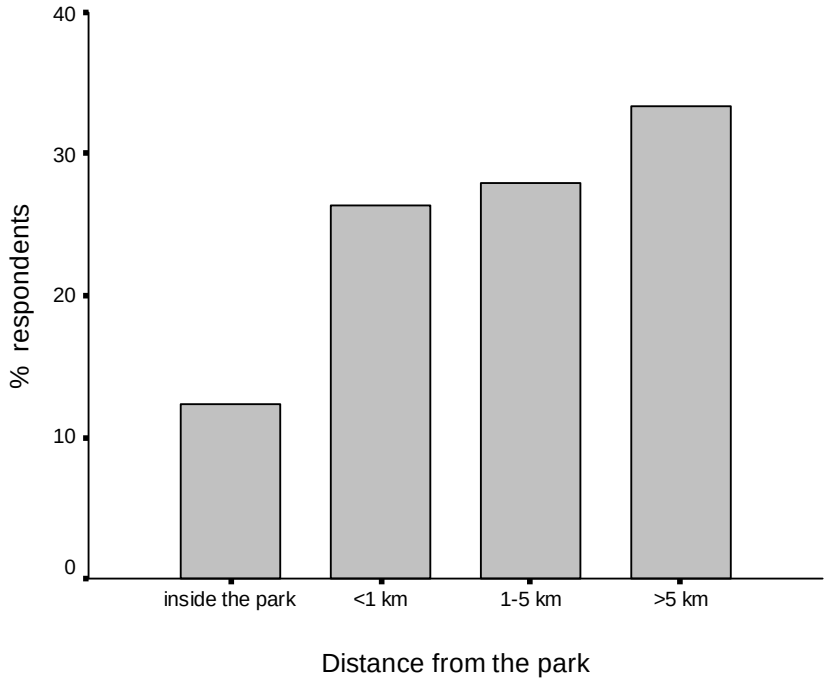

Figure 9. Respondents in terms of distance from the park.

The major economic activity of the people living in and around the Simen Mountains National Park is subsistence agriculture, which include crop farming and livestock rearing.

Average farmland holding per house hold in the study area was 2.01 ± 0.009 ha. Land owners differed across the villages ($F_{7\ 292} = 3.84$, $P < 0.05$). Based on the Tukey test, Woizero Mesk village showed significant difference when compared with Kiflo village ($P < 0.05$). Thus, Kiflo owned the largest size of farmland per household whereas Woizero Mesk holds the least size of farmland per household (Fig. 10).

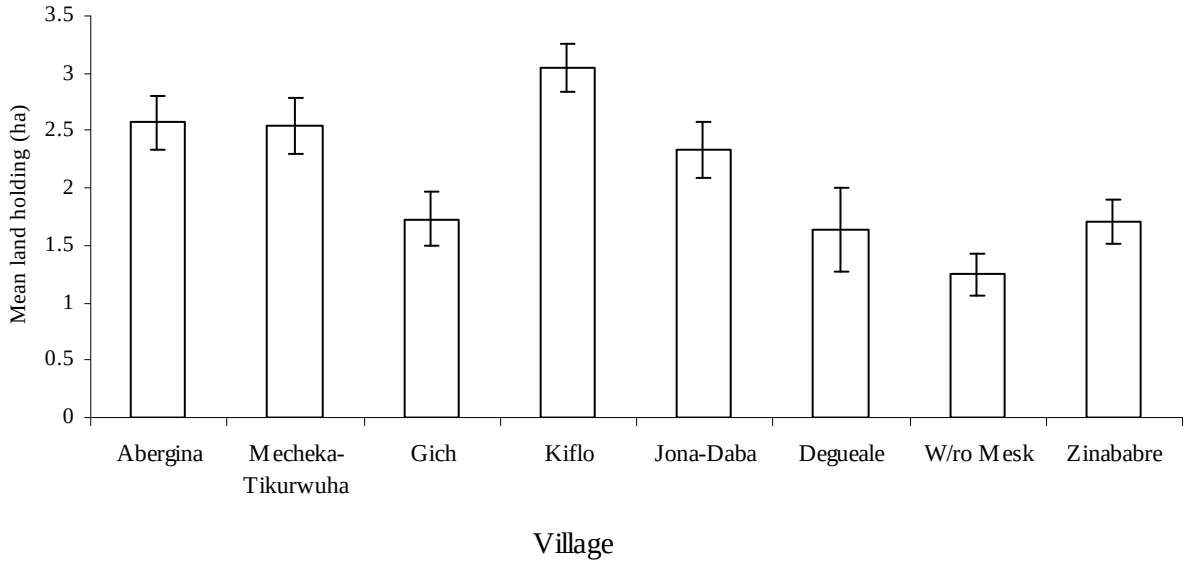

Figure 10. Mean ± SE of farmland holding per household among respondents.

The mean size of private grazing land in the study area was 0.014 ± 0.003 ha. Most (89.7 %) of the respondents did not have private grazing land. Grazing land holdings differed across all villages ($F_{7\ 292} = 6.19$, $P < 0.05$). However, the Tukey test showed significant difference between Zinababre and Abergina, Jona-Daba, Mecheka-Tikurwuha, and Gich ($P < 0.001$). In addition, there was also a significant difference when Zinababre compared with Kiflo and Deguale ($P < 0.01$). Thus, Zinababre contained the largest size of grazing land (Fig. 11).

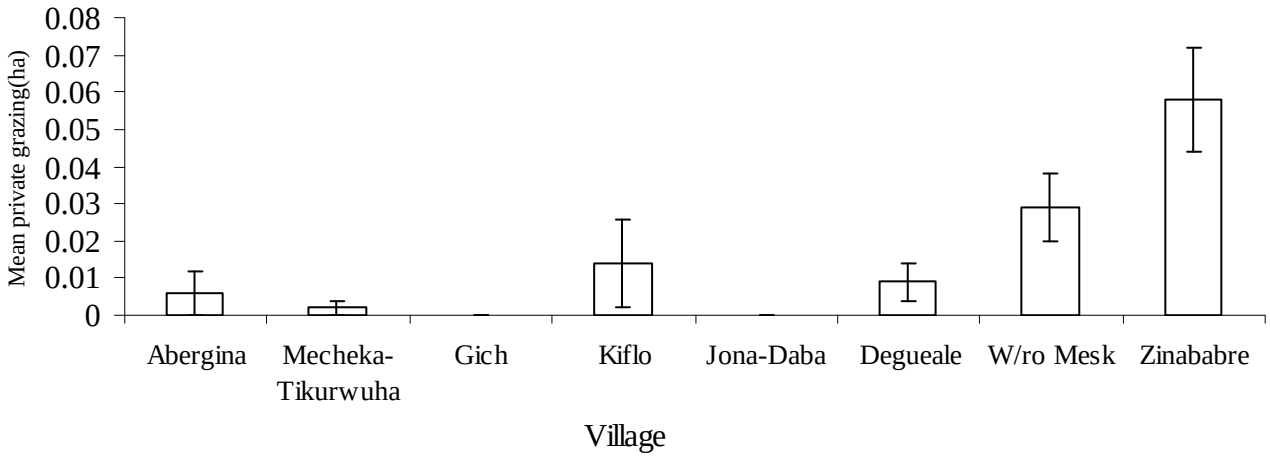

Figure 11. Mean ± SE size (ha) of private grazing land per household.

The community living in and around the Simien Mountains National Park plant trees around the edge of their farmland to prevent soil erosion from their farmland, to utilize the tree as firewood and for construction purposes. The average size (ha) of private woodlot in the area was 0.11± 0.013. 43.7 % of the respondents did not have private woodlot. The size of private woodlot was different among the eight villages ($F_{7\ 292} = 3.62$, $P < 0.05$). However, the Tukey test revealed significant difference in holding of the private woodlot in Abergina compared with Deguale ($P < 0.05$), Woizero Mesk ($P < 0.05$), and Zinababre ($P < 0.05$). Thus, Abergina contained the largest size (ha) of private woodlot (Fig. 12).

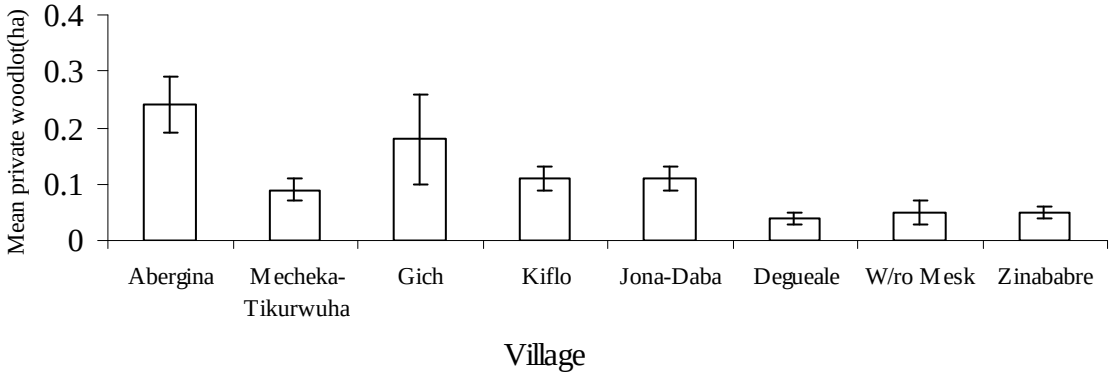

Figure 12. Mean ± SE size (ha) of private woodlot per household among the respondents.

Most (60.3%) respondents produced barley alone and the remaining (39.7%) produced additional cereal crops like wheat, bean, pea, oat, linseed, and lentil. The average grain production per household in the year 2005 was 5.69 ± 0.32 quintal. The grain production per household differed among the villages ($F_{7\ 292} = 7.88$, $P < 0.001$). However, the Tukey test showed significant difference between Zinababre and Gich ($P < 0.001$) and between Zinababre and Mecheka-Tikurwuha ($P < 0.01$). Here, Mecheka-Tikurwuha produced the least amount of grain per household next to Gich, whereas Zinababre produced the most (Fig. 13).

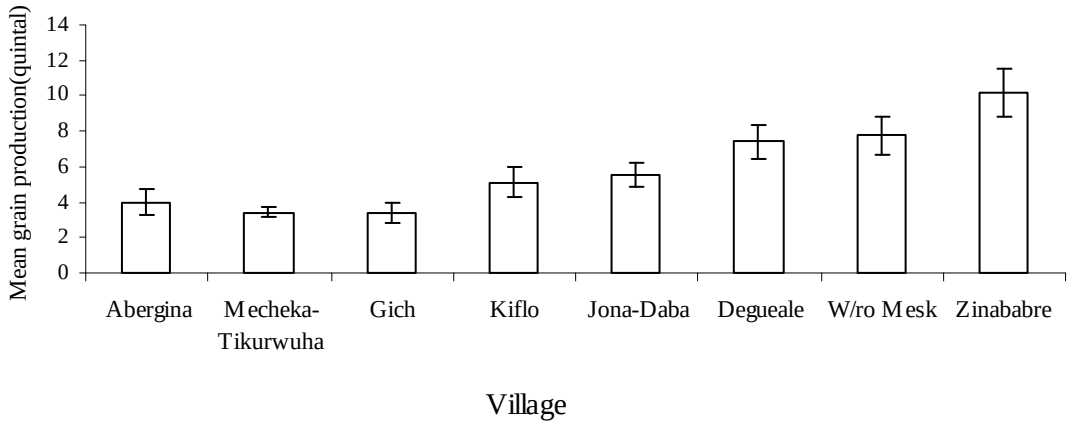

Figure 13. Mean ± SE of grain production at household level among respondents in different villages.

Besides farming, livestock rearing is the other economic activity of people living in and around the Simien Mountains National Park. The major livestock kept by the community in the area are cattle, sheep and pack animals (horse, mule and donkey). Cattle are responsible for ploughing and threshing harvested crops. They are also important for providing meat, milk and milk products. Most (75.7 %) of the respondents owned cattle. There was a significant difference among the number of cattle owned by each household in the eight villages ($F_{7\ 292} = 2.19$, $P < 0.05$). However, the Tukey test showed that there was a significant difference in mean holding of cattle between Abergina and Zinababre ($P < 0.05$). Thus, Abergina had the least number of cattle per household while Zinababre had the largest number of cattle per household (Fig. 14).

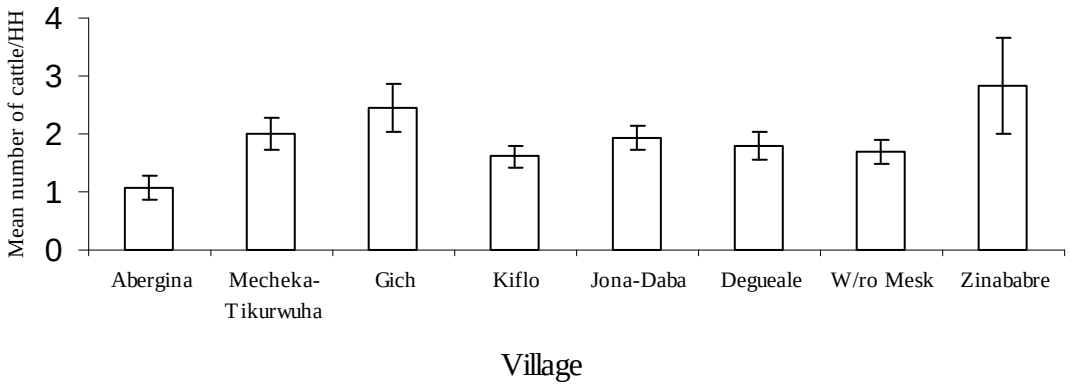

Figure 14. Mean ± SE holding of cattle per household among respondents.

Most (69.4 %) households had sheep and goats. Sheep ownership range from 0 to 50 among the respondents. Each household had mean number of 5 ± 0.39 sheep. There was no significant difference in the number of sheep holding among villages ($F_{7\ 292} = 0.52$, $P > 0.05$) (Fig. 15).

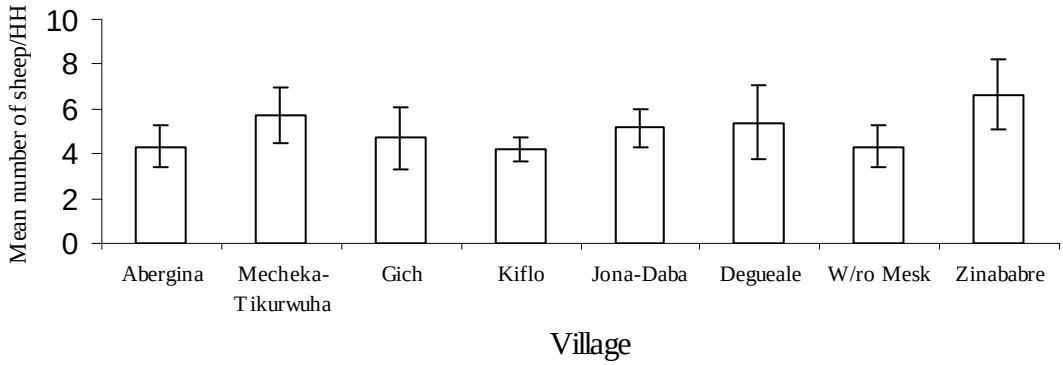

Figure 15. Mean ± SE holding of sheep per household among respondents.

31% of the households had no pack animals. The others had a mean of 1.38 ± 0.09 pack animals. There was a significant difference in holding pack animals per household among the villages ($F_{7\ 292} = 2.07$, $P < 0.05$). Using Tukey test, there was a significant difference between Mecheka-Tikurwuha and Kiflo ($P < 0.05$). Thus, Kiflo had the largest number of pack animals where as Mecheka-Tikurwuha had the least number of pack animals.

6.1.2. Resource Utilization

The community living in and around the Simien Mountains National Park utilizes the park as grazing land for their livestock. Those that are living closer to the park effectively exploit the resources throughout the year. 47.9% of the respondents utilized the park as a grazing land for their livestock (Fig. 16 and 17). There was a significant difference ($F_{7\ 292} = 93.69$, $P < 0.001$) among villages in using the park as a grazing land. Using Tukey test, the mean of utilizing the park as grazing land in Jona-Daba was compared with Deguale ($P < 0.001$), Woizero Mesk ($P < 0.001$) and Zinababre ($P < 0.001$). Thus, Jona-Daba utilized the park as grazing land most while Deguale, Woizero Mesk and Zinababre did not utilize it at all (Table 1).

Table 1. Grazing in and out side the park in different villages.

Village	n	grazing in the park (%)	grazing outside the park (%)
Abergina	42	69.0	31.0
Mecheka-Tikurwuha	35	31.4	68.6
Gich	37	92.1	7.9
Kiflo	44	93.2	6.8
Jona-Daba	42	97.6	2.4
Deguale	34	0.0	100.0
W/ro Mesk	33	0.0	100.0
Zinababre	33	0.0	100.0
Total	300	47.9	52.1

The average period of utilization of the park as a grazing land was 2.03 $\pm$ 0.11 months and the range of grazing period in the park was 2 -12 months. Villages differed significantly in the number of months they used the park for grazing purpose ($F_{7\ 292} = 118.7$, $P < 0.001$). Using the Tukey test, the mean of the number of months for grazing in Jona-Daba was compared with Deguale ($P < 0.001$), Woizero Mesk ($P < 0.001$) and Zinababre ($P < 0.001$). Therefore, Jona-Daba utilized the largest number of months (Table 2).

The duration of grazing in the park was negatively correlated ($r = -0.69$, $P < 0.05$) with distance from the park. Decreasing distance of the villages from the park increased the frequency of grazing in the park.

Figure 16. Livestock grazing inside the park.

Figure 17. Livestock grazing and farmland inside the park

Table 2. Duration of grazing in the park in different villages.

Village	n	never uses %	1-3 months %	4-6 months %	7-9 months %	10-12 months %
Abergina	42	31.0	0.0	4.8	7.1	57.1
Mecheka-Tikurwuha	35	68.6	2.9	17.1	0.0	11.4
Gich	37	7.9	0.0	0.0	0.0	92.1
Kiflo	44	6.8	0.0	0.0	0.0	93.2
Jona-Daba	42	2.4	0.0	0.0	0.0	97.6
Deguale	34	100.0	0.0	0.0	0.0	0.0
W/ro Mesk	33	100.0	0.0	0.0	0.0	0.0
Zinababre	33	100.0	0.0	0.0	0.0	0.0
Total	300	52.1	0.36	2.7	0.9	43.9

The community living in and around the SMNP used different types of plant species and cow dung as firewood. Some of the plant species are ***Erica***, St. John wort, eucalyptus, straw, ***Acacia***, giant lobelia, olive tree, ***Rumex studli***, and red hot pocker. Villages differed ($\chi^2 = 89$, df = 7, $P < 0.001$) in area for the collection of their firewood. Most respondents (63.6%) from Kiflo and some respondents from Mecheka-Tikurwuha (20%), Gich (21.1%), Jona-Daba (40.5%) and few respondents from Abergina (7.1%) collect firewood from the park (Table 3). Collection of firewood is negatively correlated with distance from the park ($r = -0.33$, $P < 0.001$). Respondents closer to the park collect firewood frequently from the park. But there was no correlation between frequency of firewood collection and family size ($r = 0.11$, $P > 0.05$).

Table 3. Firewood collection from the park and out side the park among villages.

Village	n	outside the park (%)	from the park (%)
Abergina	42	92.9	7.1
Mecheka-Tikurwuha	35	80.0	20.0
Gich	37	78.9	21.1
Kiflo	44	36.4	63.6
Jona-Daba	42	59.5	40.5
Deguale	34	100.0	0.0
W/ro Mesk	33	100.0	0.0
Zinababre	33	100.0	0.0
Total	300	80.9	19.1

6.1.3. Conservation Attitude towards Wildlife

22.3% of the respondents had excellent understanding about wildlife whereas 49.7% of the respondents had very good knowledge about wildlife in their surrounding. 21.3% of the respondents had good knowledge and only 6.7% had poor knowledge about wildlife of the area. Distance from the park was negatively correlated ($r = -0.3$, $P < 0.001$) with knowledge about wildlife of the area. There were significant differences among the different villages ($F_{7\ 292} = 7.69$, $P < 0.001$) in terms of knowledge about wildlife of the area. The Tukey test showed that there was a significant difference between Gich and Deguale ($P < 0.001$), Gich and Abergina ($P < 0.01$) and between Kiflo and Deguale ($P < 0.001$), between Kiflo and Abergina ($P < 0.001$) in the knowledge of wildlife. Thus, Gich and Kiflo had more knowledge of wildlife of the area while Deguale and Abergina had the least.

There was a difference in conservation attitude towards wildlife among the villages ($\chi^2 = 17.6$, $df = 7$, $P < 0.05$). Most respondents from Abergina (83.3 %), Gich (84.2%), Jona-Daba (73.8%), Woizero Mesk (75.8%) and Zinababre (87.9%) had positive attitudes toward wildlife.

However, 40% from Mecheka-Tikurwuha, Deguale (39.4%) and 31.8% from Kiflo had negative attitude towards wildlife (Table 4).

Table 4. Attitudes of people towards wildlife.

Village	n	negative attitude (%)	positive attitude (%)
Abergina	42	16.7	83.3
Mecheka-Tikurwuha	35	40.0	60.0
Gich	37	15.8	84.2
Kiflo	44	31.8	68.2
Jona-Daba	42	26.2	73.8
Deguale	34	39.4	60.6
W/ro Mesk	33	24.2	75.8
Zinababre	33	12.1	87.9
Total	300	25.7	74.3

There was a significant difference (χ^2 = 10, df = 1, P < 0.05) between male and female respondents in conservation attitude towards wildlife. Most (79.4%) male respondents and 58.3% of female respondents had positive conservation attitude towards wildlife. There was no significant difference (χ^2 = 8.9, df = 6, P > 0.05) in conservation attitude towards wildlife among the different age groups of the respondents. The Spearman's Correlation Coefficient showed that there was significant negative correlation (r = -0.28, P < 0.001) between problems caused by wildlife and conservation attitude. Those who faced frequent problems by wildlife had negative attitude whereas those who faced little (no) problem with the wildlife had positive attitude. Respondents at different level of education did not differ significantly ($F_{1\ 298}$ = 0.46, P > 0.05) in conservation attitude towards wildlife. There was no correlation (r = 0.12, P > 0.05) between distance of respondents from the park and conservation towards wildlife.

73.1% of the respondents had positive attitude towards the Ethiopian wolf. Villages differed (χ^2 = 16.8, df = 7, P < 0.05) in their attitude towards the Ethiopian wolf. Most respondents

from Abergina (78.6%), Gich (81.6%), Kiflo (75%), Jona-Daba (71.4%), Woizero Mesk (78.8%) and Zinababre (87.9%) had positive attitude towards the Ethiopian wolf. On the other hand, 42.9% of the respondents from Mecheka-Tikurwuha and 45.5% from Deguale had negative attitude (Table 5). However, the negative attitude towards the Ethiopian wolf in Mecheka-Tikurwuha was not related to sheep loss because the distribution of Ethiopian wolf was not around such village and hence no predation was occurred. There was no correlation ($r = -0.04$, $P > 0.05$) between predation by the Ethiopian wolf and attitude towards the Ethiopian wolf. Attitude towards the Ethiopian wolf did not depend on sheep predation.

Table 5. Attitude towards the Ethiopian wolf.

Village	n	negative attitude (%)	positive attitude (%)
Abergina	42	21.4	78.6
Mecheka-Tikurwuha	35	42.9	57.1
Gich	37	18.4	81.6
Kiflo	44	25.0	75.0
Jona-Daba	42	28.6	71.4
Deguale	34	45.5	54.5
W/ro Mesk	33	21.2	78.8
Zinababre	33	12.1	87.9
Total	300	26.9	73.1

The General Linear Model for the factors to determine the attitude of respondents towards the Ethiopian wolf explained 56.4% of the variance, and the likelihood ratio goodness of fit test just fitted the model ($P < 0.001$). Only the variable conserving wildlife is good/bad was important factor in determining the attitude towards the Ethiopian wolf. Those with positive attitude towards wildlife had more likely positive attitude towards the Ethiopian wolf (Table 6).

Table 6. Factors that determine the attitude of respondents towards the Ethiopian wolf based on logistic regression analysis.

Variables	**B**	**SE**	**df**	**Significance**
Conserving wildlife is good or bad (good)	6.10	0.60	1	0.000***
Constant	3.42	0.38	1	0.000***

Level of significance shown with *** = P<0.001

Respondents from different villages differed (χ^2 = 24.4, df =7, P < 0.05) in their attitude towards the gelada baboon. Most respondents from Abergina (59.5%), Gich (76.3%), Kiflo (70.5%), Jona-Daba (69%), Deguale (74.5%), W/ro Mesk (81.8%), and Zinababre (87.9%) had positive attitude towards the gelada baboon. However, 57.1% of the respondents from Mecheka-Tikurwuha village had negative attitude towards gelada baboon (Table 7).

Table 7. Attitude of respondents towards gelada baboon.

Village	n	negative attitude (%)	positive attitude (%)
Abergina	42	40.5	59.5
Mecheka-Tikurwuha	35	57.1	42.9
Gich	37	23.7	76.3
Kiflo	44	29.5	70.5
Jona-Daba	42	31.0	69.0
Deguale	34	25.5	74.5
W/ro Mesk	33	18.2	81.8
Zinababre	33	12.1	87.9
Total	300	29.7	70.3

There was negative correlation (r = -0.2, P < 0.001) between the attitude of respondents towards gelada baboon and crop loss. As the crop loss by gelada baboon increases, positive attitude towards gelada baboon decreases.

The General Linear Model for the factors to determine attitude of respondents towards gelada baboon explained 55.3% of variance, and the likelihood ratio goodness of fit test fitted the model (P < 0.001). Village and conserving wildlife is good/bad were important factors to determine the attitude towards gelada baboon. Villages like Abergina and Mecheka-Tikurwuha had more likely negative attitude towards gelada baboon. Those with positive attitude towards wildlife had more likely positive attitude towards gelada baboon (Table 8).

Table 8. Attitude of respondents towards gelada baboon based on logistic regression analysis.

Variables	**B**	**SE**	**df**	**Significance**
Village			7	0.01*
Abergina	-4.99	1.53	1	0.001**
Mecheka-Tikurwuha	-4.81	1.56	1	0.002**
Gich	-3.65	1.59	1	0.020*
Kiflo	-1.05	1.35	1	0.440
Jona-Daba	-3.29	1.60	1	0.040*
Deguale	-3.17	1.56	1	0.055
W/ro Mesk	-1.53	1.69	1	0.366
Zinababre	0	-	0	-
Conserving wildlife is good/bad (good)	5.19	1.45	1	0.000***
Constant	5.90	1.49	1	0.000***

Level of significance shown with * = P<0.05 ** = P<0.01, *** = P < 0.001

6.1.4. Human-Wildlife Conflict

20.9% of the respondents reported that they did not face any problem caused by wildlife where as 6.9% reported that they faced crop damage to wildlife.

25.6% reported the problem of livestock predation to wildlife and 46.6% reported the problem of livestock predation and crop damage. Problem caused by wildlife differed (χ^2 = 220.1, df = 21, P < 0.001) among the eight villages. Most (54.5%) of the respondents from Deguale did not face any problem caused by wildlife. 21.4% of the respondents from Jona-Daba had crop damage. Most (60.6%) of the respondents from Zinababre and 54.5% from Woizero Mesk faced problem of predation. However, most of the respondents from Abergina (76.2%), Mecheka-Tikurwuha (80%), Gich (63.2%), Kiflo (84.1%), and Jona-Daba (69%) challenged with both the problem of crop damage and livestock predation. In some villages like Deguale, Woizero Mesk and Zinababre, crop raiding was not recorded (Table 9).

Table 9. Percentage of respondents that faced different problems caused by wildlife.

Village	n	no conflict (%)	crop damage (%)	predation (%)	proportion of predation and crop damage (%)
Abergina	.42	4.8	9.5	9.5	76.2
Mecheka-Tikurwuha	35	2.8	14.3	2.9	80.0
Gich	37	15.7	5.3	15.8	63.2
Kiflo	44	2.3	4.5	9.1	84.1
Jona-Daba	42	2.4	21.4	7.2	69.0
Deguale	34	54.5	0.0	45.5	0.0
W/ro Mesk	33	45.5	0.0	54.5	0.0
Zinababre	33	39.4	0.0	60.6	0.0
Total	300	20.9	6.9	25.6	46.6

6.1.4.1. Conflict with the Ethiopian wolf

18.3% of the respondents lost sheep to the Ethiopian wolf alone and 8% of the respondents lost sheep to both the Ethiopian wolf and common jackal (*Canis aureus*) (Linnaeus, 1758) in the last ten years.

The average sheep loss per household by the Ethiopian wolf alone and together with common jackal in the last ten years was 1.37 $\pm$ 0.14. However, the reported sheep loss to the Ethiopian wolf differed (χ^2 = 57.9, df = 14, P < 0.001) among the eight villages. 100% of the respondents from Mecheka-Tikurwuha reported the absence of predation by Ethiopian wolf but 40.9% of the respondents from Kiflo reported predation by the Ethiopian wolf (Table 10). The average sheep loss by the Ethiopian wolf per year per household was 0.62 $\pm$ 0.09. The probability of sheep loss to the Ethiopian wolf per year per household was 0.2%. Villages differed ($F_{7\ 292}$ = 6.66, P < 0.001) in terms of loss of sheep. Using Tukey test, significant difference was observed when Kiflo was compared with Mecheka-Tikurwuha (P < 0.001), Abergina (P<0.01) and Deguale (P<0.01) (Fig. 18). The site of grazing was not correlated with sheep predation by the Ethiopian wolf (r = 0.04, P > 0.05). This means utilizing the park as grazing land did not expose the sheep for predation by the Ethiopian wolf.

Table 10. Sheep predation by the Ethiopian wolf and common jackal in different villages in the last ten years.

Village	n	no predation (%)	predation by the Ethiopian wolf (%)	predation by the Ethiopian wolf and common jackal (%)
Abergina	42	90.5	2.4	7.1
Mecheka-Tikurwuha	35	100.0	0.0	0.0
Gich	37	92.1	2.6	5.3
Kiflo	44	50.0	40.9	9.1
Jona-Daba	42	64.3	16.7	19.0
Deguale	34	60.6	30.3	9.1
W/ro Mesk	33	66.7	24.2	9.1
Zinababre	33	66.7	30.3	3.0
Total	300	73.7	18.3	8.0

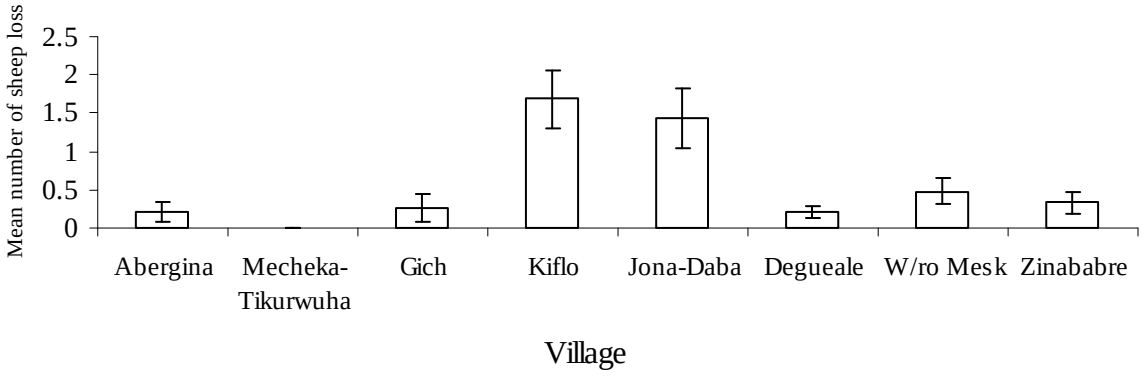

Figure 18. Mean + SE number of sheep predated per house hold per year.

Sheep loss to the Ethiopian wolf differed (χ^2 = 33, df = 6, P < 0.001) based on the distance of respondents' village from the park. However, the Ethiopian wolf also occurs outside the park around Deguale, Woizero Mesk and Zinababre villages (Table 11). Such areas have suitable habitat for the Ethiopian wolf. Distance from the park and sheep predation were not correlated (r = 0.06, P > 0.05). Thus, distance from the park was not considered as the determinant factor for sheep loss to Ethiopian wolf. However, when considering the distance from the Ethiopian wolf habitat, there was negative correlation (r = -0.44, P < 0.05) between sheep loss to the Ethiopian wolf and distance from the habitat of the Ethiopian wolf. There was also correlation (r = 0.17, P < 0.05) between predation by the Ethiopian wolf and the number of sheep present in the area. Those who had large number of sheep reported greater loss of sheep to the Ethiopian wolf than those who had less number of sheep.

Table 11. Sheep loss to the Ethiopian wolf in relation to distance from the park.

Distance from the park	n	no predation (%)	Ethiopian wolf (%)	Ethiopian wolf and common jackal (%)
Inside the park	37	91.9	2.7	5.4
<1 km	79	59.5	27.8	12.7
1-5 km	84	89.3	4.7	6.0
>5 km	100	65.0	28.0	7.0
Total	300	73.7	18.3	8.0

Predation by the Ethiopian wolf was not as such pronounced in the study area. But, still it is possible to see the trend of predation from the recorded loss in the last ten years. Villages differed (χ^2 = 140.4, df = 21, P < 0.001) in the trend of predation by the Ethiopian wolf. 33.3 % of the respondents from Zinababre reported an increasing trend of predation and respondents from Woizero Mesk (33.3%) showed decreasing trend of predation by Ethiopian wolf (Table 12).

Table 12. Trend of predation by the Ethiopian wolf among different villages.

Village	n	no predation (%)	increasing (%)	decreasing (%)	unknown (%)
Abergina	42	97.6	2.4	0.0	0.0
Mecheka-Tikurwuha	35	100.0	0.0	0.0	0.0
Gich	37	94.7	2.7	2.6	0.0
Kiflo	44	47.7	25.0	27.3	0.0
Jona-Daba	42	57.2	23.8	19.0	0.0
Deguale	34	66.7	3.0	30.3	0.0
W/ro Mesk	33	33.3	18.2	33.3	15.2
Zinababre	33	18.2	33.3	30.3	18.2
Total	300	65.3	13.7	17.3	3.7

6.1.4.2. Conflict with Gelada Baboon

The average crop loss by gelada baboon per household per year was 1.17 $\pm$ 0.1 quintal. There was a significant difference ($F_{7\ 292}$ = 13.49, P < 0.001) between villages in terms of crop loss by the gelada baboon last year. Using the Tukey test, a significant difference was observed when Abergina, Mecheka-Tikurwuha, Kiflo and Jona-Daba were compared with Deguale (P < 0.001), W/ro Mesk (P < 0.001) and Zinababre (P < 0.001). Hence, largest proportion of

crop loss was recorded in Kiflo while no crop loss was observed in Deguale, W/ro Mesk and Zinababre (Fig. 19).

Distance from the park and the frequency of crop damage by gelada baboon were negatively correlated ($r = -0.57$, $P < 0.001$). There was also correlation ($r = 0.43$, $P < 0.001$) between the type of crop grown and the type of crop damaged. 60.3% of the respondents cultivated only barley whereas 39.7% had barley together with other crops like bean, pea, wheat, oat, linseed, and lentil.

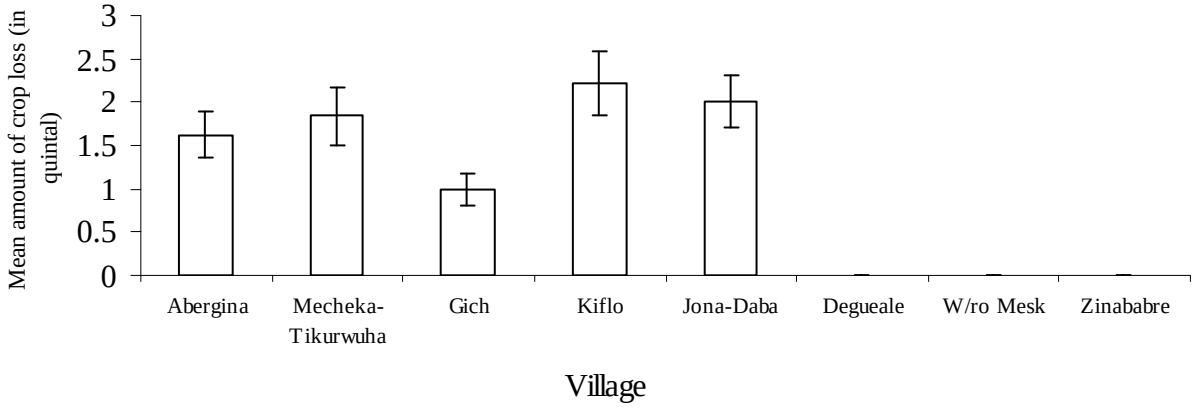

Figure 19. Mean + SE amount of crop loss per household by gelada baboon among villages.

Gelada baboons frequently caused damage on barley since it was the most common cultivated crop in the study area for a long period of time. 47.3% of the respondents reported the loss of barley. 2.3% of the respondents reported the loss of barley and bean, 0.7% of the respondents reported the loss of barley, linseed and wheat and 0.7% of the respondents reported barley and lentil. Villages significantly differed ($\chi^2 = 193.7$, df = 14, $P < 0.001$) in their response about the trend in crop damage by gelada baboon. Most respondents from Abergina (64.3%), Mecheka-Tikurwuha (86.6%), Gich (55.3%), Kiflo (70.5%), and Jona-Daba (81%) reported as increase the tendency of crop damage by gelada baboon (Table 13).

Table 13. Trend in crop damage by gelada baboon among respondents.

Village	n	unknown (%)	increased (%)	decreased (%)
Abergina	42	35.7	64.3	0.0
Mecheka-Tikurwuha	35	11.4	88.6	0.0
Gich	37	34.2	55.3	10.5
Kiflo	44	13.6	70.5	15.9
Jona-Daba	42	9.5	81.0	9.5
Deguale	34	100.0	0.0	0.0
W/ro Mesk	33	100.0	0.0	0.0
Zinababre	33	100.0	0.0	0.0
Total	300	47.0	48.0	5.0

Farmers in the study area utilized various methods to keep their farms against gelada baboon. Some of the methods are using watching eyes, chasing the gelada using dogs, and making scarecrow around the farmland. Most respondents reported using of watching eyes as very effective method. There was a significant difference (χ^2 = 223.4, df = 28, P < 0.001) among villages in was of minimizing crop damage. Most respondents from Abergina (78.6%), Maecheka-Tikurwuha (80%), Gich (57.9), Kiflo (81.8%), and Jona-Daba (61.9%) reported using watching eyes (Table 14).

Table 14. Ways of minimizing crop raiding caused by gelada baboon among different villages.

Village	n	none (%)	watching eyes (%)	watching yes and using dogs (%)	watching eyes and scarecrow (%)	all (%)
Abergina	42	14.2	78.6	4.8	2.4	0.0
Mecheka-Tikurwuha	35	8.9	80.0	2.7	2.9	5.5
Gich	37	36.8	57.9	2.7	2.6	0.0
Kiflo	44	13.6	81.8	2.3	2.3	0.0
Jona-Daba	42	9.6	61.9	11.9	9.5	7.1
Deguale	34	100.0	0.0	0.0	0.0	0.0
W/ro Mesk	33	100.0	0.0	0.0	0.0	0.0
Zinababre	33	100.0	0.0	0.0	0.0	0.0
Total	300	44 .0	48.3	3.3	2.7	1.7

Respondents significantly differed ($\chi^2 = 276.8$, df = 56, $P < 0.001$) in their expectation from the government to reduce crop loss caused by gelada baboon. 15% of the respondents expected the government to kill all the gelada baboons living there while 13.3 % wanted to minimize those problematic gelada baboons. 8% of the respondents expect possible solution from the government whereas 7% expect the government to displace the gelada baboon (Table 15). There was no correlation ($r = - 0.005$, $P > 0.05$) between farmers expectation from the government to reduce crop loss caused by gelada baboon and public attitude towards gelada baboon.

The General Linear Model for the factors to determine the crop loss caused by gelada baboon explained by 54.1% variance, and the likelihood ratio goodness of fit test just fitted the model ($P < 0.001$). Village, distance from the park and problem caused by wildlife were important factors to determine crop loss by gelada baboon.

Those who faced problem caused by wildlife more are likely to loss of crop by gelada baboon and those who live near to the park faced frequent crop loss by gelada baboon (Table 16).

Table 15. Expectation of respondents from the government to reduce crop loss caused by gelada baboon.

Respondents expectation	percentage
No response	43.3
Kill all gelada baboon	15.0
Minimize the number of gelada baboon	13.4
Get possible solution	8.0
Displace the gelada baboon	7.0
No measure needed	3.0
Help the society	4.0
Do not know	6.3
Total	100

Table 16. Factors determining crop loss by gelada baboon.

Variables	**B**	**SE**	**df**	**Significance**
Village	-0.27	0.11	1	0.019*
Distance	0.45	0.23	1	0.040
Problem caused by wildlife	0.72	0.18	1	0.000***
Constant	-1.56	0.79	1	0.048*

Level of significance shown with * = P<0.05, *** = P < 0.001

The General Linear Model for the factors to determine the problem caused by wildlife explained by 52.7% variance and the likelihood ratio goodness of fit test just fitted the model (P < 0.001). Village, site of grazing and the number of sheep were important factors in

determining the problem caused by wildlife. Mecheka-Tikurwuha and Abergina village are faced with more problems caused by wildlife. Grazing inside the park is least likely to become a factor for the problem caused by the wildlife (Table 17).

Table 17. Factors that determine the problems caused by wildlife using logistic regression.

Variables	**B**	**SE**	**df**	**Significance**
Village			7	0.001**
Abergina	2.32	0.88	1	0.008**
Mecheka-Tikurwuha	3.18	1.11	1	0.004**
Gich	-0.51	1.08	1	0.633
Kiflo	1.94	1.24	1	0.117
Jona-Daba	1.27	1.37	1	0.351
Deguale	-0.56	0.57	1	0.320
W/ro Mesk	-0.09	0.56	1	0.866
Zinababre	0	-	-	0
Grazing (inside the park)	-2.56	0.99	1	0.010*
Number of sheep	0.24	0.06	1	0.000***
Constant	1.97	1.11	1	0.074

Level of significance shown with * = P<0.05, ** = P<0.01 *** = P < 0.001

6.2. Faecal Analysis

6.2.1. Ethiopian Wolf Faecal Analysis

The Ethiopian wolf commonly feed upon rodents and occasionally consumes sheep. The occurrence of prey significantly differed (χ^2 = 128.6, df = 2, P < 0.001) in the faecal droppings. 97.8% of the total faecal droppings constituted rodents, while only 1.1% contained sheep and the remaining 1.1% contained both rodent and sheep samples (Fig. 20).

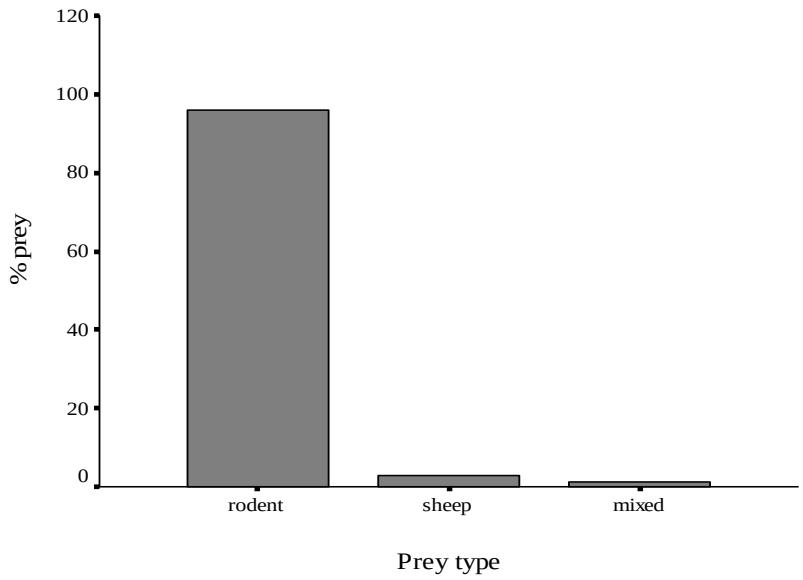

Figure 20. Percentage of different prey types in Ethiopian wolf faecal droppings samples.

The occurrence of prey type showed no significant difference (χ^2 = 3.34, df = 4, P > 0.05) between different collection sites. All the collected faecal droppings from Gich-Aynameda (100%), Atere (100%) and most (93.3 %) from Adilemlem contained rodent prey (Table 18).

Table 18. Percentage of prey type from the Ethiopian wolf faecal droppings in the three different sites.

Site of collection	rodent (%)	sheep (%)	mixed (%)
Gich-Aynameda	100.0	0.0	0.0
Adilemlem	93.3	3.3	3.3
Atere	100.0	0.0	0.0
Total	97.8	1.1	1.1

6.2.2. Gelada Baboon Faecal Analyses

The occurrence of damaged crops significantly differed (χ^2 = 48.4, df = 24, P < 0.05) across the different area. 83.3% of the faecal sample in Jinbahir contained barley whereas 80% from Tikurwuha involved barely, other grass spp (*Poaceae*), linseed and pea. The faecal samples also contained a combination of bean, pea, linseed and insect (Table 19). In addition, 18% of

the faecal samples contained only barley while 29% contained other *Poaceae (Grammineae*) species and 39% contained both barley and other *Poaceae (Grammineae*) species. The remaining proportion contained the combination of bean, pea, linseed, insect, barley and other *Poaceae (Grammineae*) species.

Table 19. Percentage of raided crops from Gelada baboon faecal dropping samples in five different collection sites.

Types of crop raided	Jinbahir (%)	Tikurwuha (%)	Abergina (%)	Kiflo (%)	Gich (%)
Barley	83.3	0.0	11.1	5.6	0.0
Other *poaceae* spp	20.7	27.6	10.3	31.0	10.3
Barley, other *poaceae* spp.	27.0	35.1	13.5	10.8	13.5
Barley, other *poaceae* spp. and insect	33.4	0.0	33.3	33.3	0.0
Barley, other *poaceae* spp. and linseed	14.3	57.1	28.6	0.0	0.0
Barley, other *poaceae* spp., linseed and pea	0.0	80.0	20.0	0.0	0.0
Total	33.0	30.0	14.0	15.0	8.0

6.3. Direct Observation on the Damage Caused by Gelada Baboon

Gelada baboon caused damage on crops like barely, linseed, pea, bean and oat. Based on the data from direct observation, large proportion of barley was damaged (Table 20).

Table 20. Field size and mean damage of crops in m^2 by gelada baboon.

crop	parts eaten	field size in m^2	mean area of damage (±SD) in m^2	number of fields measured(n)
Barley	seed	4925	99.71 (± 81.3)	24
Pea	seed	175	9.25 (± 1.06)	2
Linseed	seed	550	16.75 (± 11.98)	5
Bean	seed	100	1.13 (± 1.14)	2
Oat	seed	450	4.75 (± 1.77)	2

6.3.1. Analysis of Variation in Crop Damage between Villages

Different villages significantly differed ($\chi^2 = 1.45$, df = 4, $P < 0.05$) in their crop loss. A total of 1338 m^2 area containing different crop was trampled and raided in Tikurwuha. The least crop raiding was measured in Abergina (217 m^2) (Fig. 19).

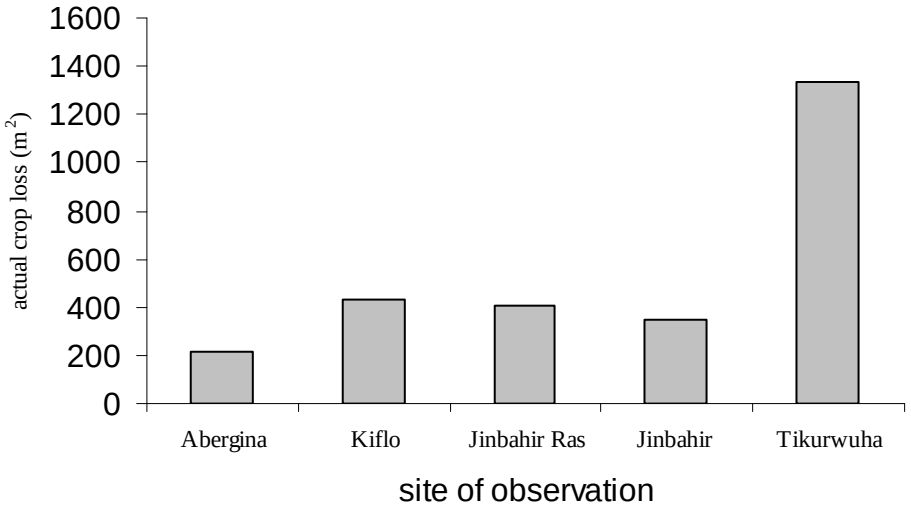

Figure 21. Size of actual crop loss in m² among five different areas.

6.3.2. Damaged Crop by Gelada Baboon

There was a significant difference ($\chi^2 = 43.8$, df = 16, $P < 0.001$) among different sites in terms of the type of crop raided. Gelada baboon caused more damage on barley in Kiflo (100%),

Jinbahir Ras (100%) and Tikurwuha (100%) because barley was the most common cultivated crop in the area. other farms also had barley together with other crops (Table 21, and Fig. 22).

Table 21. Damage of different crops by gelada baboon in different sites.

Site	barley (%)	barley and linseed (%)	barley and oat (%)	barley, oat pea and bean (%)	bean, pea and linseed (%)
Kiflo	100.0	0.0	0.0	0.0	0.0
Abergina	20.0	80.0	0.0	0.0	0.0
Jinbahir Ras	100.0	0.0	0.0	0.0	0.0
Jinbahir	0.0	0.0	60.0	20.0	20.0
Tikurwuha	100.0	0.0	0.0	0.0	0.0
Total	64.0	16.0	12.0	4.0	4.0

Figure 22. Trampled and raided barley on the field.

7. DISCUSSION

The result of this study has clearly shown that there was a strong conflict between gelada baboon and farmers living in and around the Simien Mountains National Park especially in villages like Abergina, Mecheka-Tikurwuha, Kiflo and Jona-Daba. But, there was limited conflict between the Ethiopian wolf and the surrounding community. Rather, there was a strong conflict with other carnivores like common jackal, and spotted hyena and minor conflict with leopard and hamadryas baboon.

7.1. Attitude towards wildlife

Most respondents are aware of the wildlife of the area. Respondents from Gich and Kiflo villages knew most of the species. This is because respondents of Gich village live inside the park whereas respondents of Kiflo live very close to the park and spend most of their time inside the park. Thus, they had a chance to observe the different wildlife species. On the contrary, residents from Deguale village knew few wildlife species in the area because they are very far from the park. Therefore, distance from the park was negatively correlated ($r = -0.3$, $P < 0.001$) with knowledge about wildlife of the area. Similar result was reported by Zelealem Tefera (2001), distance of the village from the Guassa area is an important factor in determining the knowledge of respondents.

Most (74.3%) respondents had positive attitude towards wildlife. Similar result has been reported by Deresse Dejene (2003) for the park. Harcourt *et al* (1986) reported that public attitude towards wildlife conservation in developing countries is positive. In addition, more recently, Deresse Dejene (2003) revealed that the local communities are not entirely antagonistic to wildlife conservation. Among the studied villages, 40% of the respondents of Mecheka-Tikurwuha village had negative attitude. This is because they frequently face problem caused by wildlife (Table 4). Problem caused by wildlife and conservation attitude towards wildlife were negatively correlated ($r = -0.28$, $P < 0.001$). Those who faced frequent problems by wildlife had negative attitude towards wildlife whereas those who faced little or no problem with the wildlife had positive attitude.

There was no significant difference in conservation attitude towards wildlife among the different age groups of the respondents. Thus, age was not considered as a factor for conservation attitude of people in the study area.

7.2. Attitude towards the Ethiopian wolf

Most (73.1%) respondents from all villages had positive attitude towards the Ethiopian wolf (Table 5). There was no correlation ($r = -0.04$, $P > 0.05$) between predation by the Ethiopian wolf and attitude towards the Ethiopian wolf. Therefore, attitude towards the Ethiopian wolf did not depend on sheep loss. The logistic regression model predicted that only those residents who had positive conservation attitude towards wildlife had more likely positive attitude towards the Ethiopian wolf (Table 6). But, factors like age, sex, educational level, family size, village, distance from the park and the presence and absence of sheep loss to Ethiopian wolf were not determinant factors for the respondents' attitude towards the Ethiopian wolf.

Many respondents living in and around the SMNP considered that the Ethiopian wolf is an endemic species and important source of income for the country. Similarly, according to Zelealem Tefera (2001), large number of residents from Guassa area knew that the Ethiopian wolf is an endemic species. In addition, as reported by Deresse Dejene (2003), the Ethiopian wolf has the potential to attract tourists and bring income to their respective areas. A study in Minnesota , U.S.A. showed that there was strong positive attitude towards timber wolf and agreed that timber wolf was symbolic of nature's wonder and beauty (Kellert, 1985). In contrast to the Ethiopian wolf, large number of respondents had negative attitude towards common jackal, leopard and spotted hyena. This was directly related to the loss of livestock in the area. Carnivores commonly generate negative attitude among the rural residents in many regions of the world since they prey upon domestic animals (Oli *et al.*, 1994).

7.3. Attitude towards Gelada baboon

Attitude towards wildlife vary among rural agricultural producers (Messmer, 2000). Most respondents had positive attitude towards gelada baboon. Especially, residents of Woizero Mesk (81.8%) and Zinababre (87.9%) had positive attitude (Table 7). Since these villages are located far from the habitat of gelada baboon and no crop damage was recorded. In

communities with subsistence economy, even small loss can generate negative attitude towards wildlife (Oli *et al.*, 1994). Thus, most (57.1%) respondents from Mecheka-Tikurwuha showed negative attitude towards gelada baboons (Table 7). This is because gelada baboons frequently cause crop damage in this area. This was confirmed not only by questionnaire survey but also by direct observation and faecal analysis (Table 19 and Fig. 21). There was negative correlation ($r = -0.2$, $P < 0.001$) between the attitude of respondents towards gelada baboon and crop loss. As the crop loss by gelada baboon increases, the attitude towards the animal decreases. Using logistic regression, villages like Abergina, and Mecheka-Tikurwuha, had more likely negative attitude towards Gelada baboon. Those with positive attitude towards wildlife had more likely positive attitude towards gelada baboon (Table 8). This is possibly due to the loss of crop. However, variables entered such as village, sex, age, family size and educational level were not the determinant factors for the attitude of respondents towards gelada baboon.

7.4. Human-Wildlife Conflict

In many parts of Africa, the conflict between local people and wildlife is the most serious problem if they are adjacent to nature reserves (Newmark *et al.*, 1994). The conflict between wildlife and local people in and around the SMNP involved crop raiding and livestock predation. 79.1% of the respondents reported problems with wildlife. Of those local people who reported problems caused by wildlife, 6.9% reported crop damage, while 25.6% reported the loss of livestock and 46.6% reported both crop damage and loss of livestock to wildlife (Table 9). Similar findings were observed from the study conducted in Tanzania on the conflict between wildlife and local people living adjacent to protected areas. Over 71% of local people surveyed, reported conflict with wildlife (Newmark *et al.*, 1994). But, in some villages like Deguale, Woizero Mesk and Zinababre, crop raiding was not observed. This is because the settlement was distant from the crop raiding animals and there was no direct contact between the farm and crop raiders.

The logistic regression model showed that respondents from Mecheka-Tikurwuha and Abergina villages are more likely to face problem caused by wildlife (Table 17). Because these villages are located close to the area where more number of animals are frequent.

7.4.1. Conflict with the Ethiopian wolf

The conflict between the Ethiopian wolf and people was not as such significant because the Ethiopian wolf feeds largely on rodent. According to Sillero-Zubiri (1994), the Ethiopian wolf is a specialist rodent eater adapted to prey upon the dense population of diurnal rodents occurring in Afro-alpine grass lands. The present finding showed only 18.3% of respondents reported sheep loss to the Ethiopian wolf (Table 10). Similar result was obtained by Zelealem Tefera (2001) that only 14.5% reported sheep loss to the Ethiopian wolf in Guassa area. Similarly, 20.5% of respondents reported having suffered from sheep depredation by the Ethiopian wolf in the last ten years (Deresse Dejene, 2003). In addition, based on the result from the faecal dropping analysis, 97.8% of the total faecal dropping samples accounted for rodent prey and only 1.1% accounted for sheep (Table 18 and Fig. 20). A study in the Bale Mountains National Park also showed that rodent accounted for 96% of all prey occurrences in the Ethiopian wolf faecal droppings (Sillero-Zubiri, 1994). The reason for the less number of sheep loss to the Ethiopian wolf is that the distribution of the Ethiopian wolf is very limited in contrast to the common jackal. At the same time, its habitat is far from the human settlement and the number is very low in the study area. However, humans attack the Ethiopian wolf in some parts of the study area. I was informed (personal com Getachew Assefa staff of the Afro-alpine Ecosystem Conservation Program) that two individuals of the Ethiopian wolf and one common jackal killed in Matba Kebele which is 5 hours track from Adilemlem.

Distance from the park was not correlated ($r = 0.06$, $P > 0.05$) with sheep loss to the Ethiopian wolf. However, in considering the distance from the Ethiopian wolf habitat, there was negative correlation ($r = -0.44$, $P < 0.05$) between sheep loss to the Ethiopian wolf and distance from the habitat of the Ethiopian wolf. That means those who live close to the habitat of the Ethiopian wolf loss more number of sheep than those who live at far distance from the habitat of the Ethiopian wolf. The Ethiopian wolf also occurs far from the park boundary around Deguale, Woizero Mesk and Zinababre. However, even though these three villages are very far from the park boundary, they are nearer to the habitat of Ethiopian wolf. Hence, a sheep loss of 28% a sheep is recorded. In addition, 27.8% of the respondents who lived very close to the park (<1 km) lost sheep to the Ethiopian wolf (Table 11). Based on the present findings, 13.7% of the respondents reported the trend of predation to the Ethiopian wolf is increasing whereas

17.3% reported as the trend decreasing. This is might be associated with the decrease in the number of the Ethiopian wolf.

7.4.2. Conflict with other Predators

In contrast to the Ethiopian wolf, there are predators like common jackal and spotted hyena that could be considered as problematic to the people living in and around the SMNP. Smaller canids such as jackals, coyotes and feral dogs are problematic as compared to large canids like grey wolves and African wild dogs (Sillero-Zubiri and Switzer, 2004). The common jackal is one of the major problematic predators in the study area. Most (57%) of the respondents reported sheep loss to common jackal (see Appendix V). Similarly, research conducted in Golan (Israel) showed that 70% of the attacks were carried out by Jackals (Yom-Tov ***et al.***, 1995). Large proportion of sheep loss to common jackal possibly is due to its number in the study area and the method of farmers to keep their livestock. Large number of the community did not have well built houses to protect their livestock against predators. So, common jackal and leopard can easily penetrate the fence and attack the sheep.

The other carnivore that had problem with the local people in the study area was leopard (***Panthera pardus***). Only 9% of the respondents reported sheep loss to leopard (see Appendix V). Similarly, a study in Annapurna Conservation Area (Nepal) showed that snow leopard was reported to kill livestock in most parts of its range (Oli ***et al.***, 1994). In the present study, 45.7% of the respondents from Mecheka-Tikurwuha and 21.4% from Abergina reported sheep loss to leopard. The possible reason could be the distribution of leopards around these villages.

The other animal that had problem with the local community in the study area was hamadryas baboon (***Papio hamadryas***). It was not highly problematic compared to common jackal and spotted hyena. 6.7% of the respondents reported the loss of sheep and goats to hamadryas baboon. Among villages, 40% of the respondents from Mecheka-Tikurwuha reported loss of sheep and goats to hamadryas baboon. It also appeared to be crop raider in the study area. The conflict caused by hamadryas baboon is restricted to Mecheka-Tikurwuha and Abergina

villages. This is possibly because such villages are very near to the low land to its habitat of the animals.

Spotted hyena (*Crocuta crocuta*) is another problematic animal for the local community living in and around the SMNP. 27% of the respondents reported the loss of domestic animals to spotted hyena (see Appendix V). Some respondents accepted the loss of livestock to spotted hyena as a result of carelessness of the owner. Unless the livestock are left on the field during night time, spotted hyenas do not dare to approach human settlements and attack livestock.

7.4.3. Conflict with Gelada baboon

Gelada baboons prominently feed upon grass species (*Poaceae*). They can also feed upon cultivated crops like barley, bean, pea, oat, lentil and linseed during harvesting season. This leads to conflict with community living in and around the SMNP. As reported by Naughton-Treves *et al.* (1998), primates were the most often identified problems in crop raiding around many African Parks. Several species of baboons (*Papio spp.*) and vervet monkeys are the most important crop raiders. Baboons in particular are important crop raiders across much of their range in Africa and Arabia. In Tanzania, they are the most troublesome crop raiders (Sillero-Zubiri and Switzer, 2001).

The average crop loss by gelada baboon per household in the study area was 1.17 ± 0.1 quintal. But larger crop loss per household per year was recorded in Kiflo, Mecheka-Tikurwha, Abergina and Jona-Daba villages (Fig. 19). This is because the farmlands in these villages are located close to the habitat of gelada baboon as compared to villages like Deguale, Woizero Mesk and Zinababre. In Mecheka-Tikurwuha village, the farmland and farmers' house are very distant to each other. Thus, farmers could not reach early morning to their farmland to prevent the attack by gelada baboon. Similarly, those farms located at the forest edges are exposed to frequent losses to primates (Naughton-Treves, 1997). The average crop loss in Gich village by gelada baboon is less. This is possibly because most farms are located near to farmers' house and farmers can reach early morning to their farmland to protect it against the gelada baboon. In considering the grain production, those villages who had problems with gelada baboon produced less amount of grain but those villages (Deguale, Woizero Mesk and Zinababre) who

did not face the problem, produced much amount of grain per year. Thus, gelada baboon had significant impact on crop production since the effect is not equally felt. Using the logistic regression model, those who faced problem by wildlife are more likely to lose crop by gelada baboon and those who live near to the park faced frequent crop loss by gelada baboon (Table 16).

The result from gelada baboon faecal analysis showed that 33% of crop loss occurred in Jinbahir. In this area, most farmlands belonged to the residents of Mecheka-Tikurwuha villages. So, there is similarity in results obtained by questionnaire survey. In addition, 30% of the faecal samples showed crop loss in Tikurwuha area. This supported the result obtained from questionnaire survey. Furthermore, the faecal analysis result showed that only 8% of crop loss occurred in Gich village (Table 19). Similarly the questionnaire survey showed that smaller proportion of crop loss occurred in this village.

Tikurwuha village lost larger proportion of crop loss per m^2 (1338 m^2) based on the result obtained from direct observation. This was possibly due to distance between the farmlands and the habitat of gelada baboon. That means, the farmlands in such village were very close to the habitat of gelada baboon. On the contrary, in Abergina area only 217 m^2 area of crop loss was measured because farmlands were far from the habitat of gelada baboon as compared to the farmlands in Tikurwuha, Jinbahir, Jinbahir Ras and Kiflo (Fig. 21). Similarly, the proximity of farms to the forest is an important factor for crop damage around Kibale (Naughton-Treves, 1998). Distance from the park and the frequency of crop damage by gelada baboon were negatively correlated ($r = -0.57$, $P < 0.001$). This means that those who lived closer (shorter distance) to the park faced frequent problem of crop damage by gelada baboon than others.

Gelada baboons frequently cause damage on barley. This is because barley was the most common cultivated crop (60.3%) in the study area. 47.3% of the respondents reported the loss of barley. In addition, some proportion of barley was also damaged together with other crops. For example, 2.3% of the respondents reported the loss of barley and bean, 0.7% of the respondents reported the loss of barley, linseed and wheat. In general, the type of crop grown and the type of crop damaged were correlated ($r = 0.43$, $P < 0.001$). Thus, frequently and

largely cultivated crops had greater chance to be damaged by the crop raiders. Barley was a largely cultivated and highly damaged crop type in the study area.

The result from faecal analysis showed that 18% of the faecal samples constituted barley whereas 29% of the faecal samples constituted other *Poaceae* species. In addition to this, using the result from direct observation, a larger proportion of barley was damaged (99.71 $\pm$ 81.3) (Table 21). Most respondents from Abergina (64.3%), Mecheka-Tikurwuha (88.6%), Gich (55.3%), Kiflo (70.5%) and Jona-Daba (81%) villages reported increase in the trend of crop damage caused by gelada baboon (Table 13). This is probably because of increase in the population of gelada baboon, human population and in the number of farmland closer to the park.

Farmers utilized various methods to protect their farm from the damage caused by gelada baboon. 48.3% of the respondents reported using watching eyes (guarding) to minimize crop damage (Table 14). Similarly, the majority of the respondents reported using guarding to minimize crop damage around the Kibale National Park (Naughton-Treves, 1997).

Respondents significantly differed in their expectation from the government to reduce crop loss. 15% of respondents were interested if the government exterminates all the gelada baboons and 13.3% need to minimize those problematic gelada baboons. 8% of respondents expect possible solution from the government whereas 7% of respondents were interested if the government displaces the gelada baboons from the farmland to other area. But, there was no correlation ($r = -0.005$, $P > 0.05$) between the farmers expectation from the government to reduce crop loss caused by gelada baboon and the public attitude towards gelada baboon. The problem is not only caused by the gelada baboon but also by the community themselves because the farmers continue to change the vegetation on the farmland. Thus, gelada baboons become attracted to the crops grown on the nearby farmland.

7.4.4. Crop loss caused by other herbivores

Hamadryas baboon (*Papio hamadryas*), vervet monkey (*Cercopithecus aethiops*) and crested porcupine (*Hystrix cristata*) were other types of crop pests in the study area. Such crop pests

are not serious pests like gelada baboon. This is because due to their minimal number in addition to being restricted to a limited area.

7.5. Human Impact on Wildlife

In Africa, the major problem facing protected areas today is the increase in human settlement of adjacent lands and the unauthorized harvesting of resources within the protected areas (Newmark, *et al*., 1993). The human population has increased continuously in and around the SMNP (Fig. 7). This high number of human population has its own impact on the wildlife population. As the number of human population increases, encroachment also increases. Then the extent of resource exploitation increases. This can easily be observed by increase in livestock grazing in the park.

47.9% of the respondents reported that they utilize the park for livestock grazing. The amount of time for grazing in the park is negatively correlated ($r = -0.69$, $P < 0.05$) with distance from the park. Decreasing (nearer) distance of the park from the villages increased the frequency of the time for grazing inside the park. Thus, larger proportion of respondent from Abergina, Gich, Kiflo, and Jona-Daba Villages reported the period of grazing for their livestock inside the park between 10-12 months. Therefore, those who are closer to the park play greater role in habitat destruction. Similarly, as reported by Zelalem Tefera (2001), livestock from nearby villages stay for longer time in Guassa area than villages from far away.

These days, more numbers of livestock are observed in the park while grazing. Frequently, gelada baboon and sheep feed upon the grass on the same field (Fig. 16 and 17). In addition to this, the cattle and human population continuously have devastated the habitat of the Ethiopian wolf. As a result, the Ethiopian wolf becomes shy and retreats to the area where the human activity is less. This was easily observed in Gich-Aynameda area leading to restricted habitat.

Fire wood collection is another type of exploitation which has a determental effect in the study area. 19.1% of the respondents reported that they collect fire wood from the park. Even though it is not pronounced like livestock grazing, it had a significant impact on the habitat quality by removing shrubby vegetation which is an important habitat for some rodent species, which are

the prime diet of the Ethiopian wolf. Similarly, fuel wood and wildlife resources are exploited by the community in Baboon Sanctuary in Belize with significant impact (Hartup, 1994). Firewood collection is negatively correlated ($r = -0.33$, $P < 0.001$) with distance from the park. Those who lived closer to the park collect firewood more frequently than those who lived far from the park. Similar result was observed on the study conducted in Guassa area. Peasant association closer to the Guassa area used firewood more frequently than those living further away (Zelealem Tefera, 2001).

The local people have been practicing firewood collection for millennia. This activity has resulted in extreme erosion and formation of gullies in some areas. The land fertility has been decreasing gradually from year to year. The output of crop obtained is decreasing time to time pushing the farmers to cultivate more plot of land. As a result, there is an increase in farmland inside the park and at the buffer zone. This has resulted in continuous land clearing leading to habitat fragmentation and decrease in abundance and diversity of species in the park and surrounding areas. Unless immediate action is taken to minimize the problem, maintaining the biodiversity of the area will be bleak.

8. CONCLUSION AND RECOMMENDATIONS

When people live together with wildlife, competition may not occur if enough resource is available. However, whenever there is insufficient resource in the area, people compete with wildlife for space, food and other resources. If this competition is severe, it results in conflict. These days, human-wildlife conflict has become an important issue for conservation biologists. The present study has shown that there is a major conflict between the surrounding people and gelada baboon. But the conflict between the local people and the Ethiopia wolf is not as such pronounced. Further more, the study also has indicated that there is sever conflict between the local people and common jackal and spotted hyena. There is also limited conflict between people and other animals like leopard, hamadryas baboon, vervet monkey and crusted porcupine with variable proportion. Even though there is conflict between wildlife and the local people, their attitude towards wildlife is generally positive. Reasonable number of respondents had positive attitude towards the Ethiopian wolf. On the other hand, an increase in human population is easily observed in the study area. This had its own impact on the wildlife resources. As human population increases, encroachment to the wildlife habitat becomes tense resulting in resource depletion.

Large numbers of people live in and close to the SMNP. At the same time more number of livestock is observed grazing inside the park in addition to the increase in the size of farmlands inside the park. Farmers expand these farmlands by clearing the nearby vegetation leading to further degradation. A mechanism should be sought where both the wildlife and people live without affecting one another. As a result, the following recommendations should be considered for sustainable living:

- ♣ The government should transfer those people living in and very close to the park to the area that is comparable in climate and other necessary conditions should be met.
- ♣ Farmers should construct and build enclosure for their livestock to prevent the loss of livestock to carnivores.
- ♣ Farmers should cooperatively keep their farm against gelada baboon and other crop raiders to minimize crop loss by using the most effective methods in the area.

- ♣ Further, investigation must be conducted to identify alternative crops that can be rejected by gelada baboon and other crop raiders in the area. Then, it should be applied for the nearby plantation to deter those crop raiders.
- ♣ Farms should be consolidated in cultivation zones away from the habitat of gelada baboon and other crop raiders.
- ♣ The park authority should provide compensation for those who loss livestock and crops outside the park area.
- ♣ The park authority should take strong measure to curtail deforestation process inside the park.
- ♣ The park authority and NGOs cooperatively should work hard to increase awareness of the local people about the importance of wildlife conservation.
- ♣ More efforts should be carried out to encompass additional areas and attentively focus to incorporate the area outside the park like Adilemlem and Atere which are suitable habitats for the Ethiopia wolf.

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APPENDIX I

Farmers Questionnaire

A. Introductory questions

1. Respondent number.....
2. Age.....
3. Sex.....
4. Residence
   a. Kebele.....
   b. Village.....
   c. Woreda.....
   d. Distance from the study area.....

5. Marital status.....
6. Family size.....
7. Educational level (for family members)

   a. no formal education.....
   b. primary education.....
   c. secondary education.....
   d. beyond secondary education.....

B. Household Economy and Resource Use

8. What is the size of your farmland?
   .....

9. What type of crop do you grow?

   a ..... c.....
   b..... d.....

10. How much did you get last year? .....
11. Do you keep livestock? If yes,

    a. number of cattle.....
    b. number of sheep and goats.....
    c. number of pack animals.....

12. Where do they graze?

    a. in the study area.....
    b. others.....

13. Do you have a private grazing land? Yes/No

a. If yes, what is the size of your private grazing land? .....
b. How many months do they graze in your private grazing land? .....

14. How long do they graze in the study area?

a. 1-3 months.....
b. 3-6 months.....
c. 6-9 months.....
d. 9-12 months.....

15. Do you have private wood plot? Yes/No
a. If yes, what is the size of your private wood plot?
16. Where do you collect your firewood?

a. from the park
b. other area

17. What do you collect as fire wood?

a. Kosso.....
b. *Acacia*.....
c. Olive tree.....
d. Zigba (*Podocarpus*).....
e. *Erica*.....
f. Eucalyptus tree.....
g. others.....

C. Conflict and Damage

18. The type of wildlife that you know in the area.....

19. Do you think conserving wildlife is important?

.....

20. What kind of problems do you face because of wildlife?

a. crop damage.....
b. predation.....
c. disease transmission.....
d. others.....

21. Have you lost any livestock to wildlife? Yes/No
a. If yes, How many?
b. What is the species involved?

22. Which animals are the most problematic in terms of livestock predation?

	predator	prey	extent(number killed)		
			last year	in the last 5 years	in the last10 years
1					
2					
3					

23. Have you ever seen wolves taking livestock?

a. type of livestock.....

b. numbers taken in the past 12 months.....

24. Is the damage increasing or decreasing?

25. How do you minimize the damage?

26. Which animals are most problematic in terms of crop damage?

number	animal type	type of damaged crop	extent of damage (last year)
1			
2			
3			

26.1 How do you minimize the damage?

26.2. Do you get help from other sources to solve your problem?

Yes..... No.....

26.3 If yes, from where do you get the help?

27. What is the tendency of the crop damage from time to time?

a. increasing.....
b. decreasing.....

28. At what time is the problem of crop damage more severe? (Specify the month)

29. At what stage do gelada baboons attack your crops most?

stages	crops				
	bean	barley	wheat	pea	others
planting					
seedling					
vegetative					
harvesting					

30. Describe the different techniques you use to control (minimize) the damage caused by gelada baboon.

i.....
ii.....
iii.....

31. Which of these techniques are:

i. most effective.....
.....

ii. least effective.....
.....

32. What measures do you think should be taken by the following in order to prevent the crop damage?

a. by the government.....
.....

.

b. by the private sector.....
.....

c. by the farmer.....
.....

APPENDIX II

Data Collection Sheet for Direct Observation on Crop Damage Caused by Gelada Baboon

Woreda----------
Kebele----------
Village ----------
Distance from the park----------
Date of damage/incident----------
Grid number----------

crop type	quality of crop before damage			field size	area of damaged portion	plant species	parts eaten	relative amount of part eaten
	good	medium	poor					
1								
2								
3								

APPENDIX III

Data Collection Sheet for Gelada Baboon faecal analysis

area	locality	altitude	position	date of collection	time of collection	age of faeces	type of crop eaten

APPENDIX IV

Data Collection Sheet for the Ethiopian wolf faecal analysis

area	locality	altitude	position	date of collection	time of collection	age of faeces	component of prey eaten	type of prey eaten

APPENDIX V

Conflict with other predators and herbivores

Table 1. Loss of sheep and goats to common jackal in different villages.

Village	n	No (%)	Yes (%)
Abergina	42	21.4	78.6
Mecheka-Tikurwuha	35	40.0	60.0
Gich	37	26.3	73.7
Kiflo	44	29.5	70.5
Jona-Daba	42	52.4	47.6
Deguale	34	69.7	30.3
W/ro Mesk	33	63.6	36.4
Zinababre	33	51.5	48.5
Total	300	43.0	57.0

Table 2. Loss of sheep and goats to leopard among different villages.

Village	n	No (%)	Yes (%)
Abergina	42	78.6	21.4
Mecheka-Tikurwuha	35	54.3	45.7
Gich	37	100.0	0.0
Kiflo	44	97.7	2.3
Jona-Daba	42	97.6	2.4
Deguale	34	100.0	0.0
W/ro Mesk	33	100.0	0.0
Zinababre	33	100.0	0.0
Total	300	91.0	9.0

Table 3. Loss of livestock to the spotted hyena among different villages.

Village	n	No (%)	Yes (%)
Abergina	42	57.1	42.9
Mecheka-Tikurwuha	35	88.6	11.4
Gich	37	52.6	47.4
Kiflo	44	34.1	65.9
Jona-Daba	42	78.6	21.4
Deguale	34	90.9	9.1
W/ro Mesk	33	100.0	0.0
Zinababre	33	100.0	0.0
Total	300	73.0	27.0

Crop Loss Caused by other Herbivores

Table 4. Percentage of crop loss caused by other crop pests

Village	n	no crop loss (%)	hamadryas baboon (%)	vervet monkey (%)	porcupine (%)
Abergina	42	95.2	4.8	0.0	0.0
Mecheka-Tikurwuha	35	60.0	28.6	8.6	2.8
Gich	37	78.9	18.4	2.7	0.0
Kiflo	44	75.0	0.0	25.0	0.0
Jona-Daba	42	90.5	0.0	9.5	0.0
Deguale	34	87.9	0.0	12.1	0.0
W/ro Mesk	33	100.0	0.0	0.0	0.0
Zinababre	33	100.0	0.0	0.0	0.0
Total	300	85.9	6.5	7.2	0.4

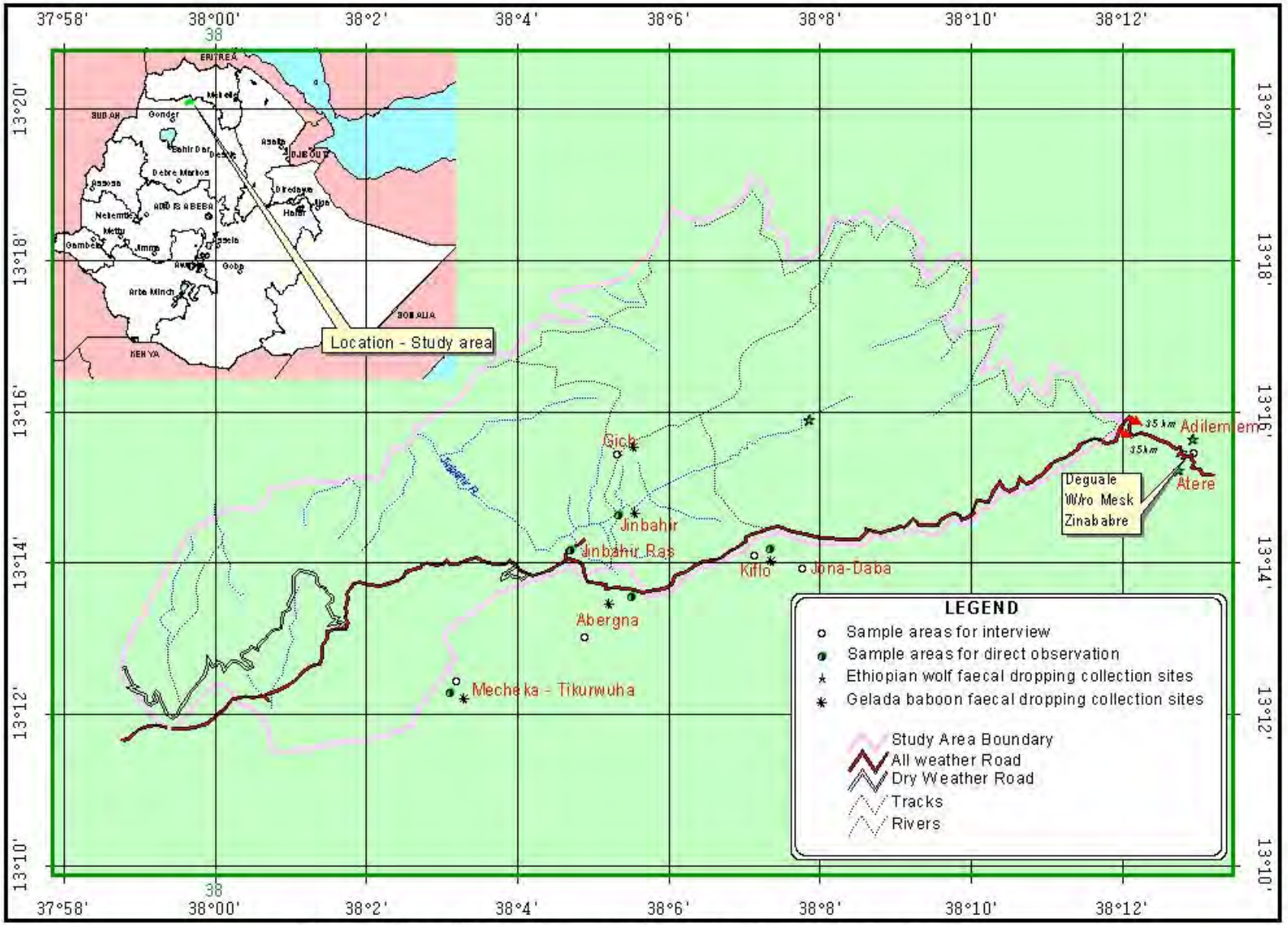

Figure 6.Map of Simien Mountains National Park and the study area